Popular Science

MONTHLY *Founded 1872*

April
1930
25 cents

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By 55 Eminent Men:
Will Our $10,000 Prize Stimulate Science?

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Explore Mysterious Island of the Dead

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~Radio~
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The Home Workshop

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It's "Rogers" time again in millions of homes

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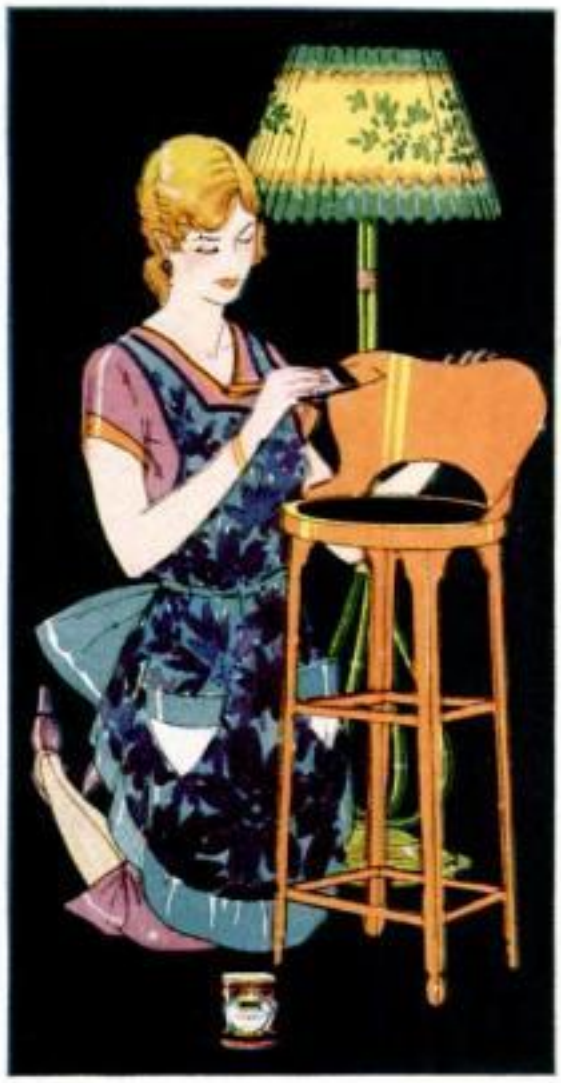

ROGERS
THE MARK OF QUALITY

BRUSHING LACQUER

The natural, quick-action finish for the home

With the warm spring sunshine, the daffodils and the violets, the fresh green grass and the singing of happy birds, *each year* comes "Rogers" time. It is the time of new life and new beauty—when the urge to clean up, to erase the smudge of a long winter, is in the air. Then, Rogers Brushing Lacquer, the modern "quick-action" finish, is the *first thought* in millions of homes. For to them "Rogers" stands for new color and new beauty —easily applied and quickly dried. Try "Rogers" in your spring cleaning and decorating. See how easily it works.

Easier to apply than ever before

Anyone can beautify with "Rogers." No experience is needed. No expert brush work is required. Merely *flow* on the bright, beautiful color with a full brush. Like cream, it *spreads*—quickly levels itself out. Then it forms a durable lustrous coating of modern color over old or new surfaces, of wood, metal or glass.

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Rogers Brushing Lacquer dries while you wait—yet is easily *handled*. Dries smooth, free from ugly laps or brush marks. Dries before dust can mar your work. Dries to a porcelain-like hardness that cleans easily—that wears and *wears* and WEARS.

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This is a clear, colorless "Rogers" lacquer which forms a tough, long-wearing, transparent coating over your linoleum. Protects the surface. Makes cleaning easy. Enhances beauty of design and colorings. Easy to apply. Dries ready to walk on in about an hour. Try it.

26 colors—at leading dealers

"Rogers" comes in 26 beautiful modern *lacquer* colors, also black, white and clear. Sold by leading paint, hardware and department stores everywhere on the "Money-Back" Guaranty printed here. Insist upon the genuine in the familiar "Oriental" can.

"Money-Back" Guaranty

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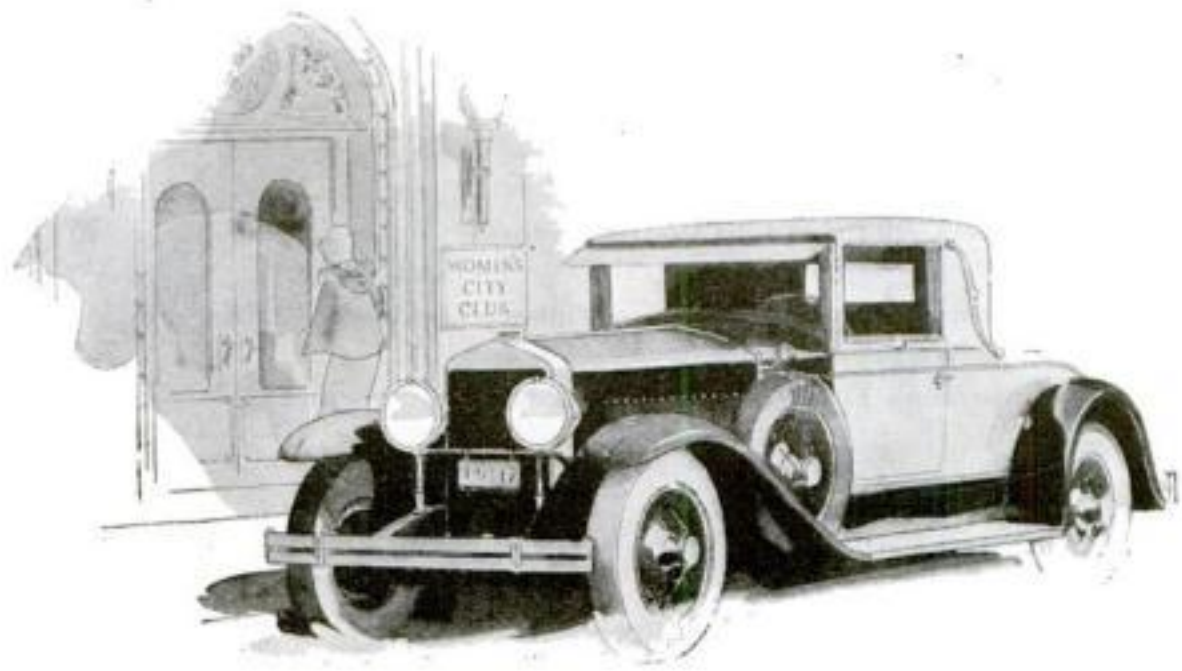
There is extra value in *good used cars* bought from reliable dealers



THE growing popularity of cars that have passed from the hands of their first owners is not the result of any sudden necessity for purse pinching.

It is due entirely to a rapidly increasing realization that a used car, when properly selected, is a good buy, offering advantages that are not to be ignored.

Thousands of business and professional men, as well as women from all walks of life, have discovered this fact and will tell you there is sound common sense and true economy in the purchase of a *good used car.*

Some of them looked at the matter this way: Before they bought a used car they had no car at all. They were without personal transportation in a day when an automobile has become a necessity.

They were not yet ready to lay out the money required for the new car they had in mind, but

they knew they could buy a used car for far less than that amount and for less, even, than *any* new car costs. And so they bought a used car, being careful to buy a *good used car.*

Others have purchased used cars because it meant they could thus own a car of higher quality, and therefore, one yielding greater personal satisfaction, than the same money could command in the new car field.

It is pretty safe to say that the vast majority of these satisfied used car owners observed certain precautions in making their purchases.

The rules they followed are simple. They picked reliable dealers with an established new car business—men with reputations to conserve and good will to preserve.

Many of these used car buyers have selected and continue to select Cadillac-La Salle dealers, because these thoroughly reliable merchants sell new cars of the highest quality and have been chosen to carry out the policies of Cadillac and General Motors.

The very nature of their new car business means that their used car stocks are likely to offer an exceptional variety. It means, also, that every used car offered is reasonably priced.

To get the utmost value in *good used cars* we suggest you visit the used car department of any Cadillac-La Salle dealer. If it happens that he has not in his own stock the particular car you are seeking, he may be able to secure it for you.

CADILLAC-LA SALLE

CADILLAC MOTOR CAR COMPANY

Division of General Motors

DETROIT, MICHIGAN OSHAWA, CANADA

25 Cents a Copy
$2.50 a Year

Popular Science
MONTHLY Founded 1872

381 Fourth Avenue
New York, N. Y.

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Popular Science Monthly for April, 1930

Stock Dividends Will Make Money Grow Faster

By CHALLISS GORE, Financial Editor

A Suggestion to Those Who Are Growing Older Faster Than They Are Getting Richer

YOU remember the day—the 16-million share day on the Stock Exchange. The prolonged and uncontrolled stock market crash had swept a multitude of dream castles into the limbo of bitter memories. It was on the 5:36 train in the evening of that day, October 29, 1929, that I first took individual notice of Sid Grimm.

He was an exception among the men on the train. His interest in shrinking security values was but casual. Had Sid been shrewd enough to sell out before the break? Was he playing the short side of the market? Had his broker neglected to send the dreaded margin call?

"What's your position in this market?" I ventured to inquire.

"Just what it has been right along . . . sitting on the side-lines . . . watching . . . envying at times . . . but spending no 'paper' profits . . . and in the last few days suffering no losses."

"How did you resist the market lure?"

"The temptation was pretty strong at times," he admitted. "For the past few years, particularly this year, most of the men in our office had me dizzy with their accounts of speculative profits. Now they are all wailing over their losses. Throughout the entire bull market I stuck to my determination to play safe with what money I had saved . . . with the result that I still have it."

"You are fortunate," I observed. "Very few men tonight are enjoying your freedom from financial worries."

"Freedom from financial worries . . . bah!" exclaimed Sid. "I haven't been playing the stock market but I have my money troubles."

My inquiring expression invited Sid to explain. "My income is increasing a little each year . . . I have a small stake tucked away . . . and manage to add to it bit by bit as I go along.

"But . . . with a growing family . . . three youngsters now . . . expenses going up . . . it's hard to get ahead very rapidly. I'll never be independent on what I can save out of my salary. I've got to find some way to make my capital grow faster."

"Why not re-invest your dividends and make your investments grow that way?" I suggested. "You know if dividends are re-invested money piles up fast."

"Like everybody else," explained Sid, "I usually anticipate the receipt of the dividends and have a need for it . . . taxes, insurance premiums, house repairs, a new piece of furniture, or something else. Furthermore, the dividends are small . . . not easy to re-invest alone . . . and if I hold them in the bank until I have a sizable amount they usually disappear."

Sid had suggested an interesting problem . . . one which is perplexing many a conservative investor. Salary savings alone are usually insufficient to gain financial independence. Speculating for a rise in stocks usually ends up in losses and always distracts one's mind from his work. Re-investment is sound in theory, but often fails in practice, as it had with Sid Grimm. And of course many investors are not financially able to re-invest all their dividends and interest.

One very practical answer to this common problem is an investment stock which pays dividends *both in cash and in stock*. There are a number of such stocks which are entitled to a rating as a sound investment. The combination of cash and stock dividends provides three important advantages to the investor:

1. A regular income in cash;
2. A steadily *increasing* cash income;
3. An investment that grows in value, independent of any advance in market price.

The key to the whole situation is that portion of the dividend which is paid in stock. After payment of each quarterly dividend the investor owns *more stock*, and draws *greater future dividends*.

Under this plan re-investment is taken care of almost automatically. The company simply takes a portion of the earnings available for dividends, invests in new stock and distributes that stock to shareholders. In paying dividends in this manner it is necessary to issue scrip certificates to represent fractions of full shares. An investor may hold these fractions until they equal a full share, when they begin to draw dividends, or he may purchase additional scrip and thus always keep his holdings in full-share units.

The benefits of the cash and stock dividend policy may be illustrated by the following table.

I have taken as an example a stock selling at $50 a share. This stock pays a quarterly dividend of 50c a share in cash and 1% in stock. This is an annual dividend basis of 4% in cash plus 4% in stock. I have assumed the initial purchase of 20 shares of stock at $50 per share—total cost $1,000. (1) The first dividend on the investment in 20 shares would be $10 cash and 2/10 of one share of stock (1% of 20 shares.) By the additional purchase of 80/100 of a share the investor would own a total of 21 shares. Therefore the second dividend would be $10.50 cash and 21/100 of a share *(Continued on page 6)*

Stock Dividends Will Make Money Grow

(Continued from page 4)

of new stock. Repeating the purchase of a fractional share, the investor's third dividend would be $11 cash and 22/100 shares; the fourth dividend, $11.50 cash and 23/100 shares; and so on. Over a period of time these tiny increases have a very substantial effect on the amount of the cash income and the value of the investment. The following tables show what happens during a 10-year period.

In this way small savings from salary are put into additional stock purchases and the stock dividends are also saved and *it is easy to make your money grow.*

TABLE A

How Your Investment Grows

At end of Years	Dividend Shares	Shares Bought	Total Shares	Total Am't Invested	Total Value
		20.	20	$1,000.00	$1,000
1	.86	3.14	24	1,118.50	1,200
2	1.02	2.98	28	1,269.50	1,400
3	1.18	2.82	32	1,412.50	1,600
4	1.34	2.66	36	1,547.50	1,800
5	1.50	2.50	40	1,674.50	2,000
6	1.66	2.34	44	1,793.50	2,200
7	1.82	2.18	48	1,904.50	2,400
8	1.98	2.02	52	2,007.50	2,600
9	2.14	1.86	56	2,102.50	2,800
10	2.30	1.70	60	2,189.50	3,000

In this 10-year example the investor triples his holdings . . . from 20 to 60 shares. At $50 each, 60 shares have a value of $3,000, but they cost only $2,189.50, so there is a capital gain of 37%, amounting to $810.50. Dividing the total cost, $2,189.50 by 60, the number of shares owned, the average cost of the $50 shares is found to be $36.49.

TABLE B

How Your Income Increases

At end of Years	Dividend Value			Average Annual Yield
	Cash	Stock	Total	
1	$43	$43	$86	8.12%
2	51	51	102	8.40%
3	59	59	118	8.68%
4	67	67	134	8.95%
5	75	75	150	9.21%
6	83	83	166	9.49%
7	91	91	182	9.65%
8	99	99	198	10.05%
9	107	107	214	10.34%
10	115	115	230	10.66%

Tables A and B are figures on the assumption that the market price of the stock does not advance at all, but remains stationary at $50 a share. Without the benefit of any market rise, or any increase in the dividend rate, the investor's average annual yield on his capital *increases from 8.12% to 10.66% in ten years.* Dividends paid in stock have been responsible for a gain in value amounting to $810.50 and an increase in total dividend value from $86 the first year to $230 the tenth year.

Purposely the factor of market price advance has been ignored in Tables A and B to illustrate how investment capital may grow of its own momentum . . . pulling itself up by its own boot straps, as it were. Of course the market price of any good stock should advance considerably in ten years. To illustrate how the investor *additionally benefits* when his security advances in market price we present Table C. This computation shows the comparative position assuming a nominal price advance of ½ point or 50c a share each three months.

TABLE C	Status if *no* price advance	Status if price advances ½ point quarterly
Total value in ten years.	$3,000.00	$4,200.00
Total amount invested.	2,189.50	2,443.25
Total Capital gain.....	810.50	1,756.75
Percentage gain.....	37.01%	71.90%
Total Dividend value, first year.....	$86.00	$87.10
Total Dividend value, tenth year.....	230.00	274.30
Income yield, first year	8.12%	8.21%
Income yield, tenth year	10.66%	11.57%
Ten year aggregate of cash and stock dividend.....	$1,580.00	$1,768.15

Perhaps the most impressive feature of Table C is the total capital gain. An investor who becomes impatient when the market price of his stock does not advance by leaps and bounds might be surprised to know that, under such circumstances as just outlined, a 2 point rise a year means $946.25 to him in ten years (the difference between $1,756.75 and $810.50).

Aside from capital and income gains, there are other advantages to the investor in dividends paid in stock. They enable a growing company to increase its working capital without the expense of a special stock offering. And the less paid for working capital the more net earnings there are for the shareholder. Before a company can issue bonds or preferred stock it is necessary to have an adequate amount of common stock outstanding. An advantage of bonds and preferred stock is that they provide working capital at a fixed cost, usually at a lower cost than common stock. When a company issues common stock as dividends it is constantly in position to raise cheap money as conditions warrant through preferred stock and bond issues. This strengthens common stock earnings.

But the conspicuous advantage to the investor of dividends paid partly in stock is that his re-investment program is taken care of for him . . . to his own gain.

To Help You Get Ahead

THE Booklets listed below will help every family in laying out a financial plan. They will be sent on request.

The House Behind the Bonds reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address: Fidelity Bond & Mortgage Co., 1188 New York Life Building, Chicago, Ill.

How to Retire in Fifteen Years is the story of a safe, sure and definite method of establishing an estate and building an independent income which will support you the rest of your life on the basis of your present living budget. Write for the booklet to Cochran & McCluer Company, 46 North Dearborn St., Chicago, Ill.

How to Get the Things You Want tells how you can *use* insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

The Guaranteed Way to Financial Independence tells how a definite monthly savings plan will bring you financial independence. Write for this booklet to Investors Syndicate, 100 North Seventh Street, Minneapolis, Minn.

FOUND ···

a way to improve ALADDIN'S LAMP

Less than three years ago a row of glow tubes sat in a test rack before a window in the Westinghouse research laboratories at East Pittsburgh.

D. D. Knowles, research engineer, glanced at them one morning and noticed that some of the tubes quite unexpectedly were glowing, while others were not. Some tubes glowed when the sun was shining and went dark on cloudy days; others responded when a hand touched the glass.

It was quickly recognized that an important new electrical development had come to light. Thousands of tubes were made and tested. Shapes of various parts were altered until a relay was available—so sensitive that a tiny pulsation of energy, less than that expended by a fly walking on a window pane, was made to control enough current to operate machines rated at thousands of horsepower. Thus was born the grid-glow tube.

Because of this development a hand waved lightly over a crystal ball in New York City started giant motors in the Homestead Steel mills hundreds of miles away. Aladdin's lamp, which had to be rubbed to get results, is outrivaled by the grid-glow tube which responds to a mere wave of the hand.

To magnify human capacities is the daily work of the Westinghouse organization. In research, in the design of electrical and allied equipment, in

the application of electrical power to new tasks, in the distribution of electrical apparatus for homes, business, and industry, Westinghouse is constantly active . . . to the end that electricity may continue in countless ways to help you get more for what you spend of time, money, and energy.

ELECTRIC POWER BUILDS BUYING POWER

Westinghouse

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Tools, Radio Apparatus, Oil Burners and Refrigerators advertised in POPULAR SCIENCE MONTHLY have been tested or investigated by the Popular Science Institute of Standards and each advertisement carries the insignia indicating approval.

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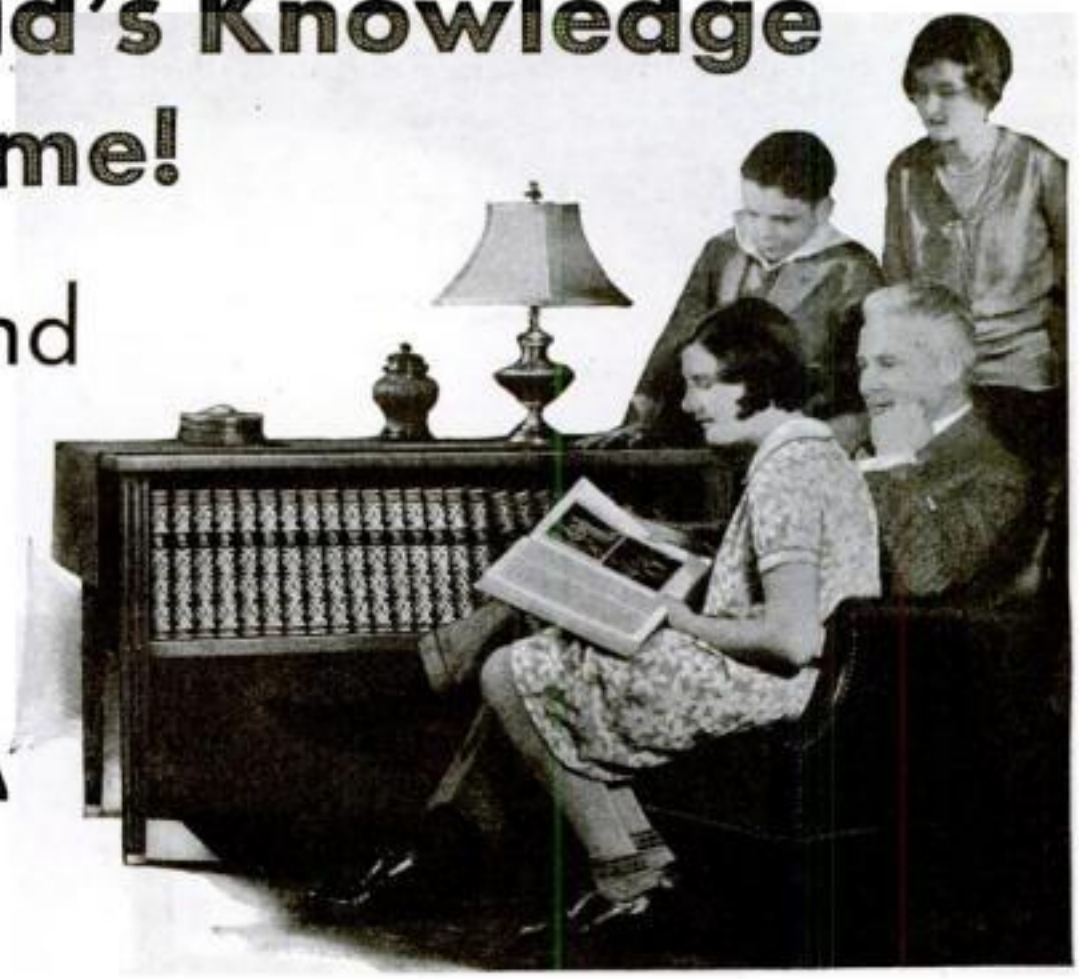

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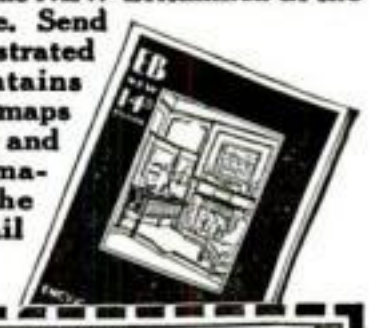

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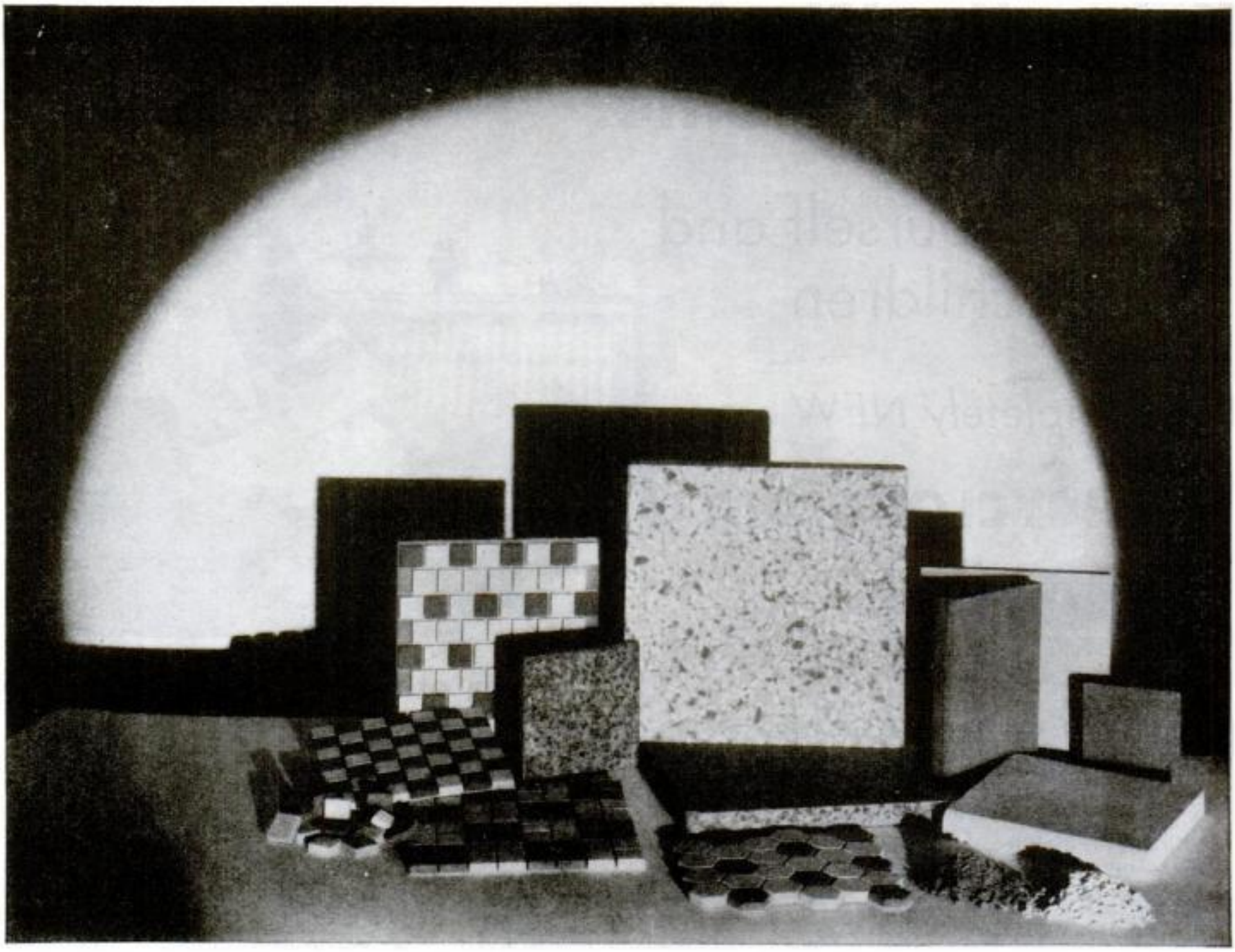

In the building industry, also, Alundum abrasive has secured a safe foothold.

Four products known as NORTON FLOORS — stair and floor tile, ceramic mosaics, aggregates for terrazzo and for cement, and precast treads

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— all non-slip

— wear resisting because of that hard, tough abrasive known to the metal industry — users of grinding wheels — the world over.

— Norton Company, Worcester, Massachusetts.

NORTON

Grinding Wheels
Grinding Machines

Refractories-Floor
and Stair Tiles

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and hear Talking Pictures that sound NATURAL . . .

WHEN you go to a motion picture theatre nowadays you have a right to hear the voices of your favorite stars reproduced with full justice to their artistry. Fortunately you can do just that—provided you select a theatre which displays the "Western Electric equipped" sign. This apparatus reproduces speech and music in natural tones because it was designed and made by the world's acknowledged leaders in the science of sound—Bell Telephone Laboratories and Western Electric. It is the result of an experience of over half a century in making telephone apparatus that reproduces the voice with naturalness. For thorough enjoyment of your talking picture entertainment, look for the Western Electric sign.

Western Electric
SOUND SYSTEM
THE VOICE OF ACTION

MADE BY THE MAKERS OF YOUR TELEPHONE

More Comforts for the Home

New Methods in Heating and Ventilating Are Now Available to All House Owners Whether Their Buildings Are New or Old

This is the way it used to be in the long winter fight to keep comfortable.

PECULIARLY fortunate is the man who is building a home today. He has at his disposal, as the result of scientific advance in construction, elaborate means for making his dwelling comfortable. Nowhere is this more apparent than in the matter of heating and ventilation.

The owner of a home already built can also avail himself of these improvements. A comparatively small expenditure often will modernize a system of heating and ventilation and provide the many benefits automatically enjoyed by the new homebuilder.

It is because experts now realize the importance not only of heat, but of other essential factors, that this revolution has come about. The result is apparent in new and improved methods of supplying heat and ventilation and in other modern aids to comfort.

Heat, in winter, is one of the things that makes a house comfortable. By modern standards, a heating system must deliver heat when and where it is wanted, with little fuss or bother, and at a minimum of expense, for a wasteful heating plant has no place in the modern scheme of things. Moreover, heat today means controlled, even, adequate warmth at all hours, and there is no excuse nor necessity for putting up with less in this age of comfort.

But the thermometer is not the only gage of comfort in the house. Dry, stuffy heat is especially bad. Furniture dries out and cracks, veneering comes loose, and the irritating effect of extreme dryness on throat and nasal passages renders the occupants particularly subject to colds and throat infections. The proper degree of humidity, on the other hand, gives the air freshness and vitality. Engineers have learned at last to go Nature one better, and to provide ways within a home for controlling humidity at will.

Such things as fresh air and refreshing breezes also have their place in home comfort. It is no longer necessary to regard these things in a hit-or-miss way. They can be provided for in the design of a home along with its heating and ventilating equipment.

WITH modern means to control temperature, humidity, and quality of air, the home dweller today is better off in his house than former kings in their palaces.

Courtesy of National Warm Air Heating Association

Just a touch to the thermostat and the temperature of the home is quickly changed. One of the modern ways to home comfort.

He can make his own weather to order and, so far as external conditions go, he can be as comfortable as he pleases.

The advance in the design of house-heating equipment has been so rapid recently that many people are not acquainted even with the major developments. Much has been done toward perfecting warm air, steam, vapor, and hot-water systems. Radical changes in the design of radiators, made possible by the substitution of lightweight metals for heavy cast iron, have vastly improved the radiation efficiency of radiators in proportion to size, and indicate that the evolution of heating apparatus is by no means at an end. Growing use of oil and gas as fuels, together with a wider application of thermostatic control of heating, have made homes much more uniformly livable than they have ever before.

INSTITUTE BULLETINS

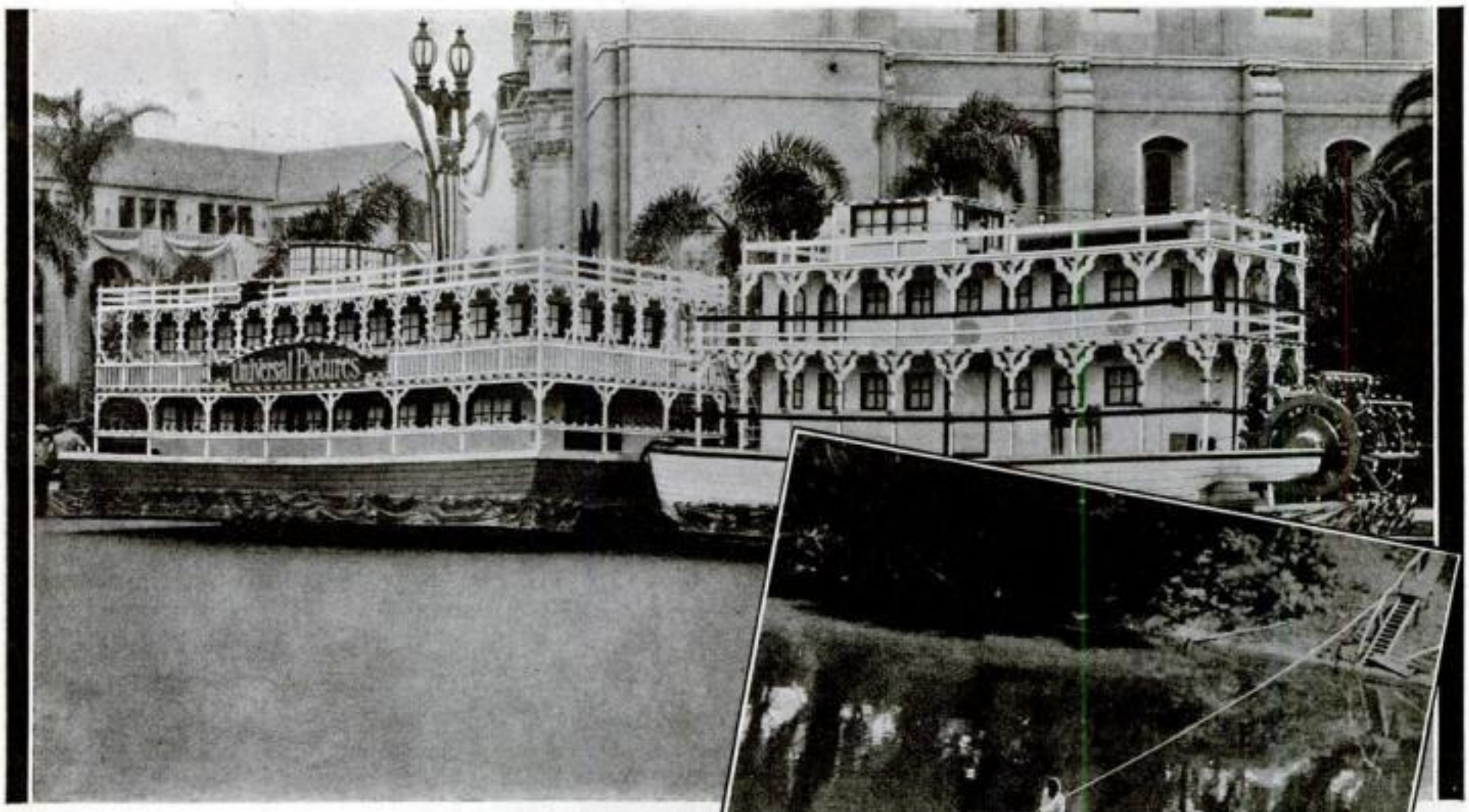
House Heating and Ventilating*
Insulation in Building Construction*
List of Approved Tools
List of Approved Radio Products
List of Approved Oil Heating Devices
Advice on Installing Oil Heat
Refrigeration for the Home*

*25-cent charge for starred bulletins

FOR the benefit of the home builder or owner who has neither the time nor the means to find out for himself the advances that have been made in heating and ventilating equipment and their individual applicability to his problems, Popular Science Institute has conducted a survey of the entire field, putting all the data obtained in a booklet which has just been published. This booklet describes modern ways of heating and ventilating, together with the principles on which they operate and the best ways of securing good results from them.

In presenting this information, it has been the aim of Popular Science Institute to outline the merits of modern systems and devices in such a way that the man who is building a new home or modernizing one already built will have a comprehensive knowledge of just what is on the market. The information given is sufficiently complete and specific to provide a basis for an intelligent decision. For example, the three chapters on fuels give in detail the advantages of different grades of coal, oil, and gas, together with information on their relative cost and the proper methods for obtaining the best results.

Besides this booklet on "House Heating and Ventilating" (available at 25 cents a copy), the Institute will gladly supply readers with any additional or special information they require on this subject. Address: Popular Science Institute, 381 Fourth Ave., New York, N. Y.



The "Show Boat"— and work boats, too, *are made of* PRESDWOOD

The romantic period in American history, when show boats carried entertainment to towns along the Mississippi, is faithfully portrayed in the Universal Pictures' production, "Show Boat." But there is just as much romance back of the industry which contributes to the advertising and production of the play itself.

In a thriving Mississippi town, wood is blown apart and pressed together again in a patented process which makes the grainless wood boards called Masonite Presdwood. And it is this readily worked and easily painted material which is so successfully used in reproducing the "Show Boat" pictured above.

Does not crack or splinter

This workability of Presdwood has also led to its extensive use for set construction in Hollywood studios. For Presdwood does not crack or split. It does not splinter. It is dense and smooth, and so tough and strong that the same pieces are used over and over, in set after set.

But Presdwood's "marine" uses are not confined to the "Show Boat," as evidenced by the Presdwood ferry boat built by John H. Parmalee, prominent Nashville architect. He proved, as have many boat builders, the ability of this grainless wood to resist moisture and withstand the hardest usage.

Panels homes—lines concrete forms

Presdwood provides beautiful paneling for homes, smooth lining for concrete forms. It builds incubators and iceboxes, kitchen cabinets and breakfast nooks, aisle runners and dance hall floors. It makes show window backgrounds, motor truck paneling and outdoor signs; makes things better, lowers their cost.

If you manufacture in quantity or make things at home, you should read the Presdwood booklet. It is sent, Free, with a sample of Presdwood, on request.

MASONITE CORPORATION
111 West Washington Street, Chicago, Illinois

MASONITE CORPORATION, Dept. D-4, 111 W. Washington St., Chicago, Ill.
Please send me, Free, a sample of Masonite Presdwood and the Presdwood booklet.

Name.....

Address.....

City..... *State*.....

Masonite
PRESDWOOD
Made by the makers of
MASONITE STRUCTURAL INSULATION

Our Readers Say

No Room for the Editor

I WANT to throw a brickbat which I am sure a large number of your readers will agree is alright. Why doesn't the Editor give an answer to each letter printed or express his views, as the case may be? There are many scientific questions and arguments raised, to which a lot of us would like to know the correct answer. Will you please consider this, Mr. Editor?—C. R. L., Fargo, N. D.

This section of the magazine is the creation of POPULAR SCIENCE MONTHLY *readers, and belongs to them. If the Editor wished to intrude (which he does not), and offer his own answers to the questions and arguments presented, many of the interesting letters would be crowded out. As it is, we have space for comparatively few of the hundreds of fine letters received each month. Most of the questions raised in one issue of the magazine are answered by readers in subsequent issues—and better answered, in many cases, than if the Editor took a hand.*

From a Famous Family

ON BEHALF of the Executive Committee of The Fitch Family Association of America, I desire to express our great appreciation of your article in the January, 1930, number, page 33, giving Lieut. John Fitch, Revolutionary officer, credit for the "World's first successful steamboat." The article entitled "Sailing down the Centuries" is in error in stating that James Rumsey exhibited a steamboat on the Potomac in 1785, but we are not "kicking" about this, as Lieut. Fitch made a successful trial with his first steamboat model in the spring of 1785.

I purchased several extra copies of the January number and sent them to friends—I also sent out about seventy-five post cards to various persons interested in Lieut. Fitch's achievement, telling them to be sure to secure a copy of the January number of the POPULAR SCIENCE MONTHLY.

This letter is written to let you know that the F. F. A. appreciates your accuracy in giving Lieut. Fitch deserved credit for the *world's first successful steamboat.*—Roscoe Conkling Fitch, Detroit, Mich.

But Suppose Your Two-Shaft Elevator Broke Down?

IN POPULAR SCIENCE MONTHLY is an article on the limit to the size of skyscrapers due to the space occupied by elevators. Now why not, instead of having one cage to each shaft, have several to each shaft and move them continually up one shaft, over, and down another? I have never seen a cable street car system, but I imagine a system similar to this. Instead of having a row of elevator shafts and cages, say ten, there would be only two shafts and in these ten cages, some going up, some going down, and transferring at the top and bottom. The cages would be one or more stories apart, as street cars are one or more blocks apart. Please let me know if you think this is sensible, and if anyone might be interested.—O. L., Fort Branch, Ind.

What Can a Poor Girl Do?

I'VE BEEN reading all the readers' problems in "Our Readers Say," but I haven't found an answer to *mine* yet. What do you do when the boys come to the house and, finding the POPULAR SCIENCE, won't do anything but read it all evening?—(Miss) M. W., Sedro Woolley, Wash.

The Pleasure's All Ours

HAVE been reading P.S.M. since 1926. I like all the articles. Think there is no magazine on the market nearly so good. The Home Workshop is my favorite department. Please make it bigger. Have made several pieces of furniture from your drawings. They have been the means of spending many a pleasant hour and I thank you.—P. K., Mars, Pa.

Ant Puzzle Solved; Now for Another

ABOUT T. O. B.'s problem of the ant on the log: The log must turn over twelve times, requiring the ant to travel twelve feet around and five feet lengthwise. We have, therefore, a triangle with legs of five and twelve feet respectively, and a hypotenuse of thirteen feet, the latter being the distance covered by the ant.

But here is one I have not seen solved:

How long a board, twelve inches wide, with the ends cut off square, can be laid flat upon the floor of a room sixteen by twenty feet?—F. L. H., Portland, Ore.

Why Not Charge Rent?

I HAVE been taking yearly subscriptions of POPULAR SCIENCE MONTHLY for about three years. It is sent to my home while I am away at boarding school. Each copy, by the time I get home, has been read from cover to cover, and when I take it up to school I have to fight to keep it until I have read it myself. What am I going to do about it?—W. C. J., Annapolis, Md.

Florida's "Big Tree"

IN YOUR February issue I noticed an item about a cypress tree 2,000 years old and fifteen feet in girth. Such trees are common in some parts of Florida and I, myself, have seen several this size. There is, however, one tree, a cypress, too, that I think deserves special mention. That is a certain tree near Longwood, Fla., about twelve miles north of Orlando, that is known to the natives as "Big Tree" and was so known to the Indians before Columbus discovered America. I once asked an Indian where he was from, and he answered, "Big Tree."

This mighty tree is about forty-nine feet in circumference, and is about sixty or seventy-five feet tall. The trunk is easily fifteen feet in circumference *at the top*. Some idea of its size may be gained when I say it took me seventeen paces, stepping about three feet each step, to walk entirely around the tree.

If Professor Kurz estimates the age of the little cypress he mentioned at 2,000 to 2,800 years, I should, as a matter of curiosity, like to have him estimate the age of the tree I am writing about. I have heard it estimated by one who does such figuring that there is enough lumber in "Big Tree" to build three houses.—(Miss) E. L., Fernandina, Fla.

Do You Agree?

IN REPLY to G. N. G., of London, about scrapping the submarines, the late war demonstrated the effectiveness of the sub as an offensive weapon in defensive warfare. The deaths in these submarine disasters are deaths in the cause of national safety, just the same as on the field of battle, just the same as in the testing of any new device for public or national safety.

A nation at war must and will resort to any expedient to win, especially if the odds are against them. War must and will be made more horrible each and every time it is fought. No nation, however powerful, can scrap any weapon until it has proven to be positively obsolete—unless they wish to be overwhelmed by the ambition of other nations.

The only way to stop war is to make it more horrible than any man can conceive.—G. C. H., St. Paul, Minn.

Bus Planes a Solution?

IN February POPULAR SCIENCE MONTHLY you mention the difference of opinion between Assen Jordanoff and O. R. Angelillo. Mr. Jordanoff claims it is dangerous to fly over a city at low altitude, and Mr. Angelillo is planning a roof airport in the heart of Los Angeles. Perhaps both men are right.

My plan would be to have all planes from other cities land at the commercial airport and the passengers would take a bus plane to the roof landing field in the heart of the city. In this way only scheduled planes would land at the roof airport and private planes would not be allowed over the city. All bus planes flying over the city would be required by law to fly at a sufficient altitude to be within gliding distance of a landing place at all times. Thus motor failure would not mean a forced landing on housetops.

This plane service to the center of a city would correspond to the taxi and bus service between a railroad station and business center.—U. P. McC., Oberlin, O.

It's a Good Sign, Anyway

IN ANSWER to the statement by Professor Cajori in regards to the Mexican origin of our dollar sign I am presenting an equally if not more plausible answer to the origin of the dollar

sign. Originally the sign was a U with an S superimposed on it, standing for the United States. Later this degenerated to $ for the sake of saving time.

Why should the U. S. adopt the Mexican sign for her own use? Also how did the P of Cajori's explanation degenerate to the two bars? Perhaps the professor is a little prejudiced to his own race.—R. A. P., Meridan, Conn.

Never Too Young to Learn

ASSEN JORDANOFF hit the nail on the head when he said that "thousands of Americans under sixteen want to learn to fly." I am only fourteen, but I have been taking Jordanoff's advice (to learn motors and familiarize yourself with the parts of an airplane, the theory of flight, and the terms around an air field) for about two years. I have received your plans (No. 114) for a "toy airplane cockpit with controls" and am going to start work soon. Here's hoping for more of Jordanoff's adventures.—W. W., Vienna, S. D.

In a Nutshell

I HAVE enjoyed every issue of your magazine for the last three years, and I hope you will keep on with the articles pertaining to aviation."—W. S. A., Glen Ridge, N. J.

I think that your earlier issues, particularly those of a year or two back, were far better. I agree with some of your readers that POPULAR SCIENCE has too much aviation articles. Let's have more interesting Home Workshop articles.—B. M. R., Brooklyn, N. Y.

I am a reader of your magazine and enjoy it very much. I am particularly interested in your models of airplanes, ships, etc.—W. B., Painted Post, N. Y.

The magazine is better every issue than the one preceding.—M. A. C., Bremerton, Wash.

It seems to me from a scientific standpoint your magazine should cover some of the most important matters in health building, the foundation for doing anything in life.—M. A. C. N., Salt Lake City, Utah.

Good for You, Parson!

DESPITE the fact that I am a parson, I have to "fix it" (some "it") in our home most of the time, and I know the clever and ingenious ways and means and tricks and technique of fixing are to be found so graphically illustrated and explained in POPULAR SCIENCE MONTHLY that even a parson can see how it's done and do it.

You are producing an indispensable magazine, interesting and inspiring, one that should be in every home today. For your able editors and illustrators and special writers are not only keeping us abreast of the times, but also quickening our imaginations, doing again the great work performed by the prophets and seers of old, revealing to us the glories of life that shall be!—Rev. H. L. R., Minneapolis, Minn.

That Walking Fish Is Making Us Popeyed

PLEASE tell H. W. M. that his "walking fish" is no more than a type of newt or salamander. Its body structure in no way resembles that of a fish. It is a dark chocolate brown in color and looks like a lizard and is very sluggish out of the water. In this locality it is a nuisance to anglers and is shunned by the small barefooted waders as the most poisonous of reptiles. We call it "water dog" owing to the resemblance of its broad head and gills to the head and drooping ears of a dog. Also its wriggling motion while crawling in the mud heightens the impression of a dog wagging its tail until the hind legs skid. Some of the northern streams of northern Ohio are lousy with them in all sizes up to eighteen inches in length.

While swimming its gills spread out fan shape. It loses its canine resemblance and presents one of the most repulsive sights I have ever seen.

Just a word of praise for your magazine. It's great. I have read it for ten years and never missed an issue. The most interesting part is what the readers say, with their amusing views and arguments.—K. D. F., Canal Fulton, O.

But Where Would Amos 'n Andy Come In?

A LARGE and probably growing class of radio receiver users no longer listen to the radio. Except on very special occasions they do not deliberately sit down to enjoy the program. To them, a radio receiver is useful mainly as a purveyor of music to form a pleasant and stimulating background for conversation, reading, card games, or during the daytime for household duties. They class the radio with the orchestra in a theater—an accompaniment and not the main show.

The deliberately penetrating voice of the announcer handing out a lot of blarney about soap, tooth paste, or some other commonplace commodity does not make a good background for anything.

Someday somebody is going to invent an ultra-sensitive appliance that will instantly cut out the loudspeaker when anything except music comes through and then turn it on again after the talking is finished. Make such a device so that it would, in addition, distinguish either way between jazz and other music and it would be priceless.—B. A. W., Rutland, Vt.

From a Model Maker

I NOTE that the readers of POPULAR SCIENCE MONTHLY interested in ship models are to have a new treat in forthcoming numbers and that you request some suggestions as to preferences. Personally, I find it hard to choose between the *Hartford* and the destroyer. In fact, I hope we may have both sooner or later.

I made the little motor boat that ran about two years ago for a small nephew as a Christmas present. It really was a beauty. I am also interested in the stagecoach model and would like to see more of that line.—H. E. H., Grandview, Wash.

Getting a Look-In

BY CHANCE I dropped into our public library one evening and sat at a table where there were a dozen different magazines to read. The fellow next to me was reading a magazine for which there seemed to be a big demand. I was curious. I waited till closing to have a glance at the contents, but I had to wait three nights before I could read it. I found every article interesting. P. S. M. is something different than all the magazines in the place. I am ordering a subscription so that I can really get a look-in.—D. I., South Shields, England.

A Life-Saver on the Farm

I AM a farmer boy, 19 years old and just through high school. I am helping my father on the farm for a year before starting college. I like engineering and similar subjects but dislike farming, so you can imagine a fellow gets pretty lonesome sometimes, sixteen miles from a good library over roads which are impassable much of the winter. Here's where good old P. S. M. is saving my life. I have tried other scientific magazines, but they all seem cheap, miserable productions compared with P. S. M. Here's why I prefer P. S. M.: if there is anything I like to see in a magazine it's good, clear pictures and lots of them, and of course related to the subject matter. P. S. M. has them.—J. A. M., Lennox, S. D.

Found It Here, of Course

THE miniature stagecoach in the February issue of POPULAR SCIENCE MONTHLY is what I have been looking for for some time. I was working on the Mississippi steamboat but I will drop it, start working on the stagecoach, and finish the steamboat some other time.—R. P. H., Connellsville, Pa.

Wanted—A New Name for Vitamins

SEEING the short piece on the discovery of two new vitamins in P. S. M. reminds me of a question. Why don't scientists change the name of these substances? The name was originally given them because they were supposed to be essential to life (Latin "vita") and to be chemical "amines"—thus "vita-amines." But now chemists and doctors know that they are not amines, and that they are not necessary to life. If some substances should happen to be discovered which had the above qualities, what would become of the white elephant "vitamin"?—R. D. B., Middletown, Conn.

There'll Be No More Peace at the Hague

YANKEE talkies may be all Greek to a Frenchman, an Italian, a German, or a Spaniard, as you say in your editorial in the February issue, but there are some countries in Europe where the loquacious celluloid strips from America are making an enormous hit. Recent letters and newspapers from Holland, for example, have shown me that American talkies are "packing 'em in" at the movie houses in the principal cities, such as Amsterdam, Rotterdam, and The Hague. In fact, the newspapers carry plaints, very much like those heard along Broadway, to the effect that the talkies are killing the legitimate theater, and musicians are perturbed by the growing popularity of "Sonny Boy" and similar theme songs in the land of the dikes and the windmills.—M. W., New York City.

A Gold Mine

YOUR *Pocket Guide to Science* is worth more than the subscription price alone. It certainly is a gold mine of information. I have long been a reader of POPULAR SCIENCE and consider it the best scientific magazine. It gets better each month.—D. W., Gainesville, Ga.

Once a week do this . . . .

Note to Medical and Dental Profession

When prescribing a mouth wash for *germicidal* purposes, make certain that it *is* a germicide; and not merely a colored preparation which is only deodorant and astringent.

Invigorates scalp . . . CHECKS DANDRUFF

WHENEVER you wash your hair—and most people do it once a week—douse full strength Listerine on the scalp either before or after the rinse. Then massage the scalp and hair vigorously for several minutes.

You will be simply delighted by the wonderful feeling of cleanness and scalp exhilaration that follows this treatment.

Moreover, it is unquestionably one of the best treatments for dandruff—to prevent it, and to overcome it once it has started.

Many hundreds of people have told us that since making Listerine a part of the weekly shampoo, their scalp has felt better, their hair has looked more attractive, and is entirely free from loose dandruff.

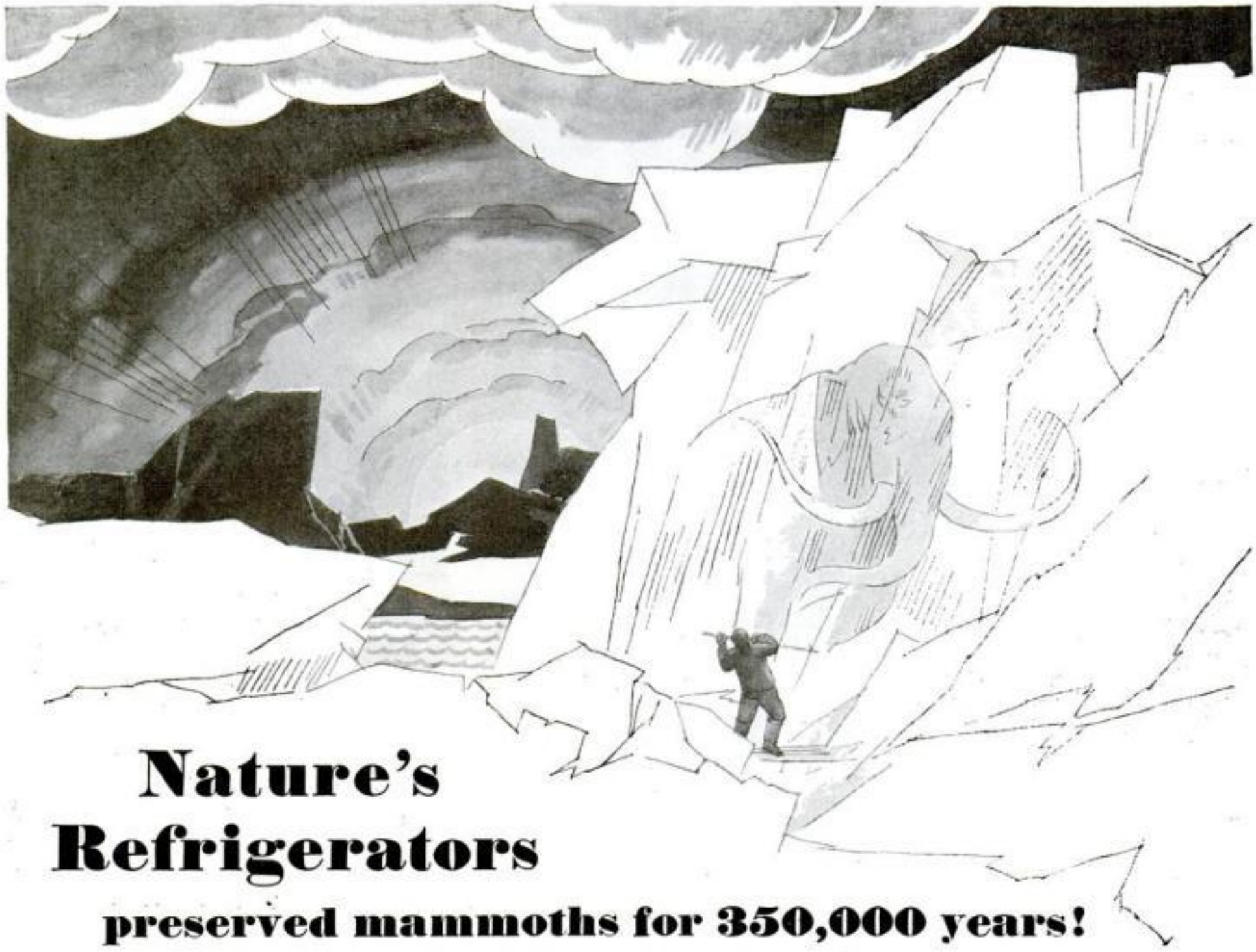
Of course, if dandruff does get a start, it will be necessary to repeat the Listerine treatment systematically for several days, using a little olive oil in conjunction with it if the scalp or hair is excessively dry.

Listerine checks dandruff because it attacks infection that causes it, removes and dissolves the particles of loose dandruff and heals and soothes the scalp.

LISTERINE

Lambert Pharmacal Company, St. Louis, Mo., U. S. A.

kills 200,000,000 germs in 15 seconds



Nature's Refrigerators

preserved mammoths for 350,000 years!

They're still digging mammoth meat out of the ice up in the Arctic circle. Preserved by nature for more than 350,000 years.

Overwhelmed by the softness of the ground, the mammoths were quickly sealed in muddy tombs . . . then insulated by the frozen earth . . . blanketed over with heavy sheets of ice and snow.

Down in the cane-brakes of the South, nature has produced *another* insulation . . . much handier in form than ice-sealed crypts, and better suited to modern refrigeration uses.

Protecting the heart of sugar-cane stalks is cane-fibre . . . long, strong and tough . . . which today is interlaced into sturdy insulating boards called Celotex!

Nature surely intended Celotex for refrigerating purposes, because she provided it with millions of tiny sealed air cells . . . just the thing that is required for effective insulation *against heat.*

Industry long ago discovered the value of Celotex as refrigerator insulation.

Ninety-one per cent of all railway refrigerator cars, built in a single year, have been insulated with Celotex.

Thirty manufacturers, including several of the leaders of mechanical refrigerators and ice boxes, use Celotex.

When you buy a refrigerator for your home, ask if it is insulated with Celotex, for Celotex insulation insures a constant, low temperature in your cabinet . . . shortens the running time of the refrigerating unit . . . saves ice.

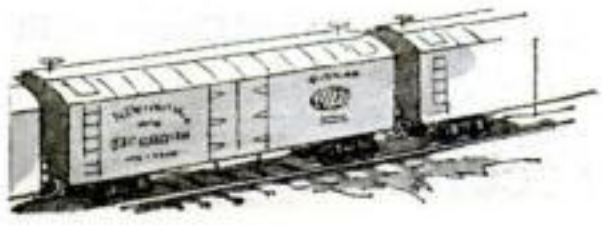
Celotex helps to keep your vegetables field-green and crisp . . . your fruits firm and delicious . . . your other perishable foods sweet and fresh.

It is nature's own refrigerator insulation.

THE CELOTEX COMPANY
919 North Michigan Avenue
Chicago, Illinois

In Canada: Alexander Murray & Co., Ltd., Montreal. Sales Distributors throughout the world. Reliable dealers can supply Celotex Standard Building Board and Celotex Lath.

More than 44,000 refrigerator cars are now insulated with Celotex . . . to protect the fruits, vegetables, meats and other perishable foods that you eat . . . to keep them healthfully and deliciously fresh.



CELOTEX
BRAND
INSULATING CANE BOARD

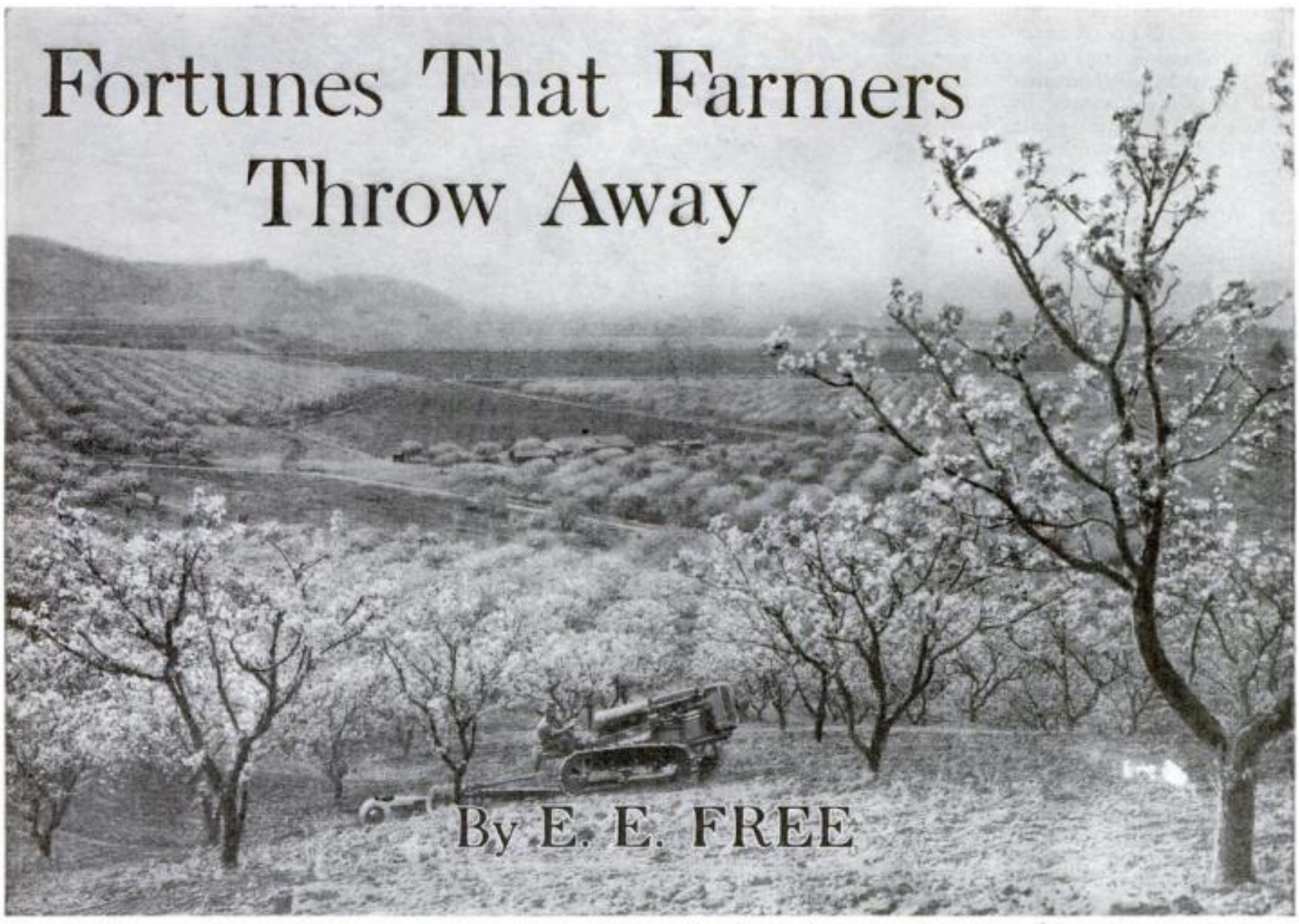
NATURE'S OWN REFRIGERATOR INSULATION

The word CELOTEX (Reg. U. S. Pat. Off.) is the trademark of and indicates manufacture by The Celotex Company Chicago, Illinois.

Popular Science MONTHLY

APRIL, 1930 TRAVIS HOKE *Editor* VOL. 116, NO. 4

Fortunes That Farmers Throw Away



By E. E. FREE

Prosperity shines upon the farmers who grow fruit, since chemists have found a use for so many of their by-products that now nothing is thrown away as waste. Markets have been developed for the juices, oils and acids extracted from the pulp and then the pulp is sold as stock food.

Capitalists Are Betting a Million Dollars That They Can Stop Waste and Save the American Farmer

A MILLION dollars is bet on saving the American farmer.

A corporation, capitalized at that amount, was recently organized to put cornstalks, the chief agricultural product of the United States, to industrial uses. Millions of dollars' worth of cornstalks are discarded as waste by the farmers each year.

The new organization, formed after years of scientific research, mainly conducted by Professor O. R. Sweeney of Iowa State College, is backed by a group of distinguished agriculturalists, business men, and financiers. Its principal purpose will be the development of processes of converting cornstalks into thin lumber substitutes of low price but good quality. Later, other by-products of corn may be turned into useful materials. Thus, it is expected, an enormous leak in American agricultural economics will be stopped.

For a decade Professor Sweeney has been devoting his knowledge and inventive ability to cornstalks. About 150,000,000 tons of them, he computes, are raised by American farmers every year; far more than any other American agricultural product and more than all such products put together, except hay.

These cornstalks, hoed, fertilized and saved from insects, the farmer throws away. Only the fact that this has always been done keeps sane people from laughing at the absurd spectacle of millions of farmers carefully raising cornstalks and doing nothing with them.

More is involved than the mere future prosperity of the corn belt, for there can be little doubt that the real trouble with American agriculture, the chronic disease which is keeping the farmer so poor that continual political "relief" is demanded to prevent universal bankruptcy, has nothing to do with soil or marketing or the tariff but is merely the failure of American farmers to keep up with the applications of scientific research—something that has been done by virtually every other major industry.

Manufacturing industries maintain research laboratories costing millions of dollars every year to study processes, improve products, and prevent wastes. Meat packers, as the familiar phrase goes, "save everything but the squeal." Gases from coke ovens, once thrown away, now yield chemical products which have become the mainstays of the business. The waste oils from refineries are turned into good gasoline; slag from blast furnaces makes excellent brick and mineral wool; even city garbage is made into lu-

bricating grease, stock food, fertilizer, and combustible gas.

Farmers, however, still throw away every year billions of tons not only of cornstalks but of wheat straw, oat hulls, peanut shells, potato and vegetable vines, cull fruits and fruit pits, and scores of other by-products. Only in a few agricultural industries, where there has been some degree of centralization and unified management, like cotton growing, sugar production, and fruit canning, has real effort been made to see if these farm wastes, by far the vastest industrial wastes in the world, can profitably be stopped.

IN 1928, the average farm worker in the United States earned the equivalent of about $1,000. In the same year the average worker in manufacturing industries earned nearly $1,700 and the average store clerk or other person in mercantile pursuits over $2,100. That is the farm story in a nutshell. The farmer earns too little for his time; less than half the average income of all persons gainfully employed in the United States.

I know farmers who live in modern homes and have automobiles, electric light, gas cook stoves, radios, and the other comforts and luxuries that the city dweller enjoys. They are not "gentleman farmers," either, but examples of the good, old-fashioned "dirt" variety. But they are rare exceptions. Until they are the rule, until every American farmhouse equals the average city home, until the farmer can send his children to college, insure his life adequately, and find reasonable facilities for culture and social life near his home, there will be something radically wrong with American agriculture. For the way that farmers now live is not merely a symptom of the farm's economic sickness, it is perhaps that disorder's chief cause. If farm life is uncomfortable and uninteresting, if it yields less money and fewer of the things that people desire than living and working in towns and cities, then most people who have brains and energy to manage it will get away from the farm as quickly as possible—which is precisely what nearly everybody has been doing for fifty years.

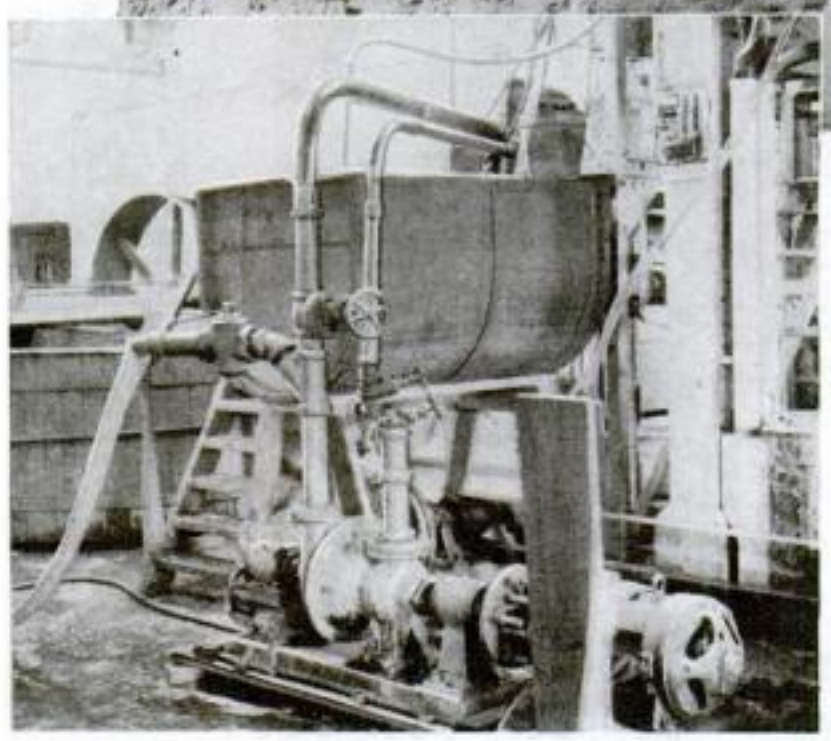
TO GET back these lost brains, farming must provide more money. Politics is but a temporary expedient, for no government can be expected indefinitely to support a losing industry. Fewer farms and shortage of foodstuffs might mean higher prices for a year or two, but such a situation is still less in the public interest and could not last. Better fertilizers, stimulating "plant pills," "trained bacteria" to improve the fertility of soils, increased use of farm machinery and of rural electrification, more highly diversified crops, and dozens of other expedients suggested by farmers, soil experts, or politicians all are but partial remedies for the deep-seated disease of American farming.

For a real cure, farming must accept the lesson taught by other industries. Farms must industrialize, adopt efficient processes, finance scientific research, save and use every possible by-product.

So far, it must be confessed, agriculture has had more harm than benefit from industrial chemistry. Indigo, once an agricultural staple in India, is now altogether synthetic. Synthetic tanning materials have also cut into the farmer's markets. Chemical processes of making hard edible fats from peanut oil and cottonseed oil have resulted in decreased prices and markets for natural lard, once the main "money crop" of the hog raiser. But synthetic chemistry has nothing against the farmer. It is merely that the farm's competitors have been quicker to call it in. Now it must be the farmer's turn.

Cornstalks, the raw material of the new industry to be based on Professor Sweeney's researches, contain three chief materials. Most of the fresh stalk is water, easily removed by drying. The solid matter which is left contains about one

Nut and orange growers have found the secret of big cash returns: coöperation and no waste.



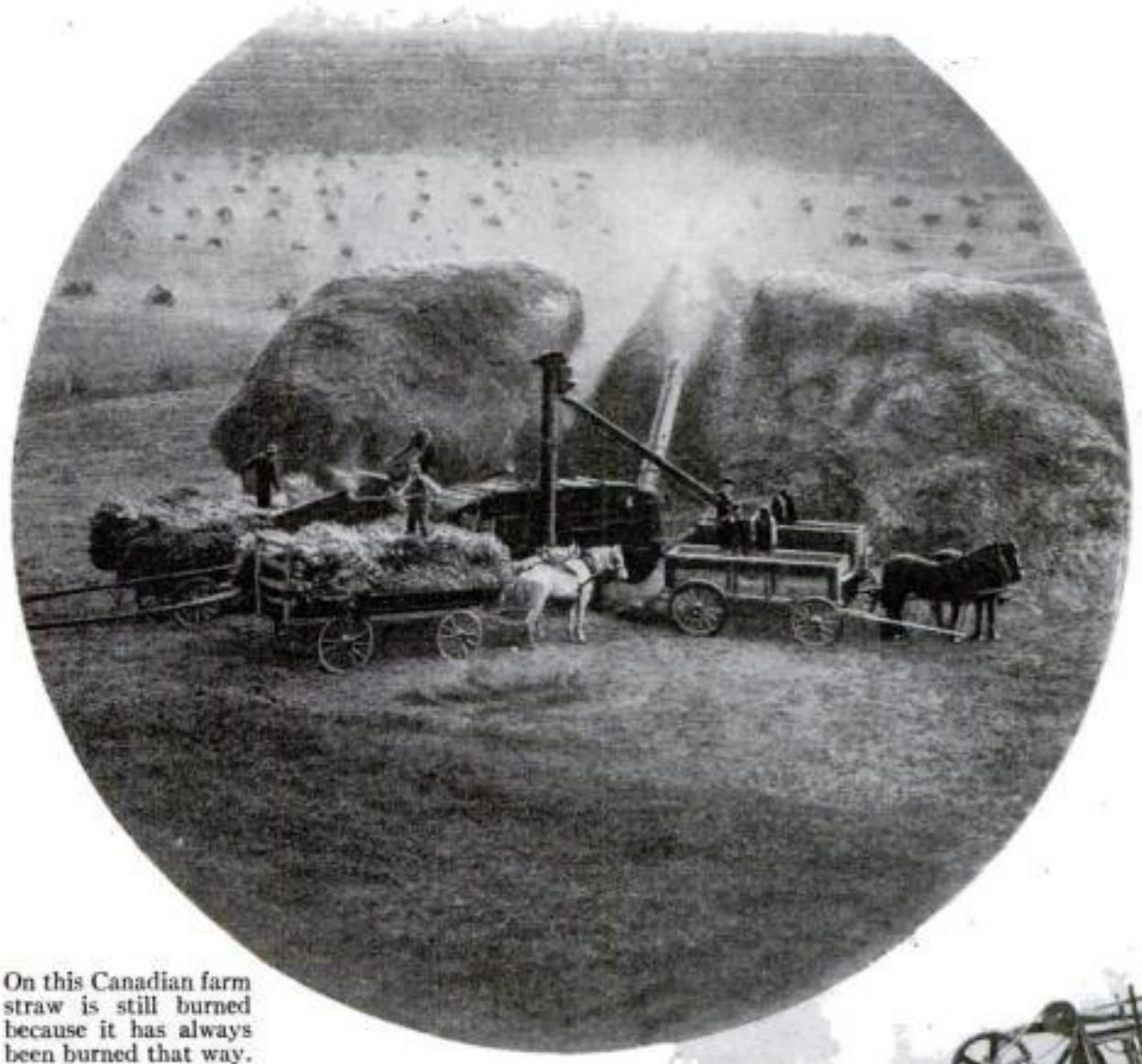
Cornstalk pulp was tested in this chemical machinery by Professor Sweeney as a laboratory test tube is used by chemists.

third of its weight as a gummy chemical material called lignin, also present in most kinds of wood. About another third is composed of pentosans, which resemble the sticky substances in ordinary mucilage and remotely resemble starch. These pentosans are not useful for human food, but can be utilized by several kinds of bacteria with the production, it is expected, of a number of useful chemicals. The other third of the weight of the average cornstalk is ordinary cellulose; the white, fibrous material of cotton or of the wood fiber used to make paper.

Paper can be made, indeed, from the cellulose fiber of cornstalks, as can many other cellulose products ranging from smokeless powder to rayon. It is proposed, however, that the first main product of the new cornstalk industry be a kind of synthetic building material of the wall board class, made by compressing the cellulose fiber and much of the lignin of the stalks into hard, woodlike sheets.

ANOTHER material, made in Professor Sweeney's laboratory and recently tested by the United States Bureau of Standards under the name of "maizolith" or "maize stone," is said to consist of the cellulose fiber of the stalks treated chemically so that the fibrous structure degenerates into a featureless jelly. This jelly is then compressed and hardened into a substance resembling hard rubber and which, it is believed, may be useful for electric insulation, for the making of noiseless gears, and for similar purposes.

From one hundred pounds of natural cornstalks it is possible to produce, Professor Sweeney finds, twenty-four pounds of the liquid called furfural, now finding increasing uses in chemical industries as a solvent and selling for eight or nine cents a pound. Two of Professor Sweeney's associates at Iowa State College, Dr. Henry Gilman and A. P. Hewlett, have been able, by further chemical manipulation of the cornstalk materials, to make a new sweetening material said to be 300



On this Canadian farm straw is still burned because it has always been burned that way.

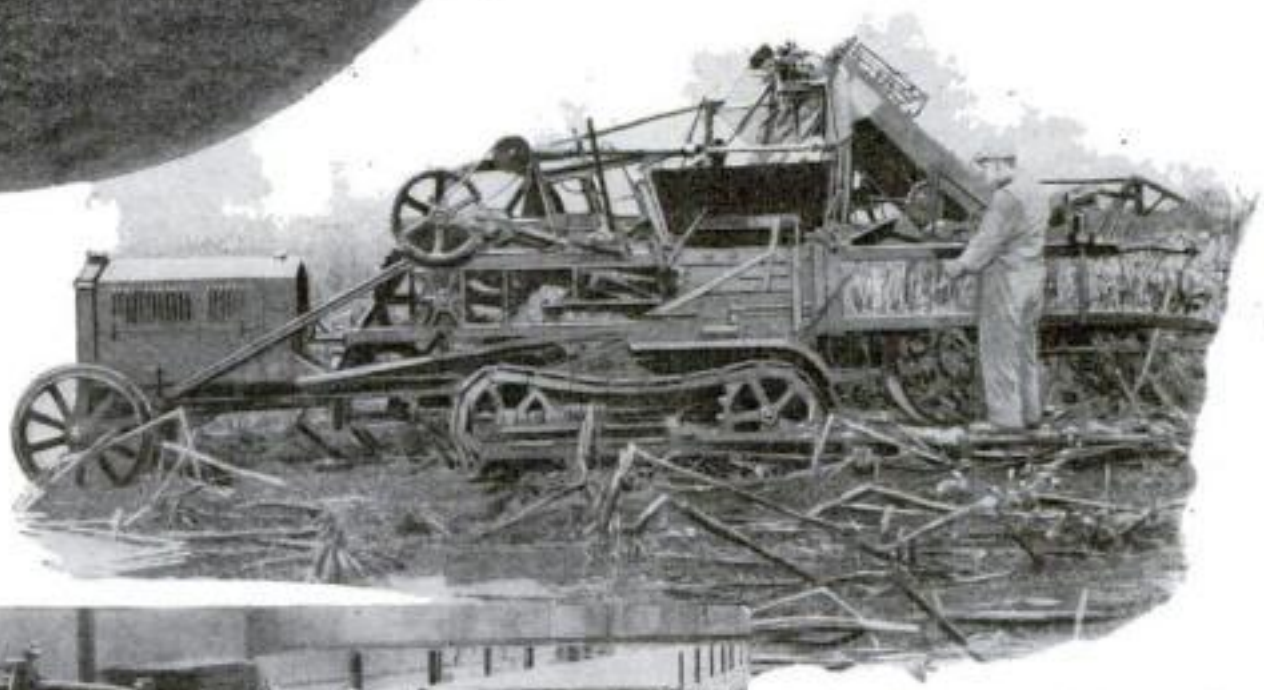
times as sweet as sugar and possibly useful for persons unable to eat sugar, as coal-tar chemicals, like saccharine, are used now. More than three thousand separate chemical materials can be produced, Professor Sweeney states, from the three fundamental raw materials lignin, pentosan, and cellulose present in the country's enormous waste of cornstalks.

But there are many agricultural wastes in the United States almost equal in amount to the cornstalk harvest and probably with equal possibilities.

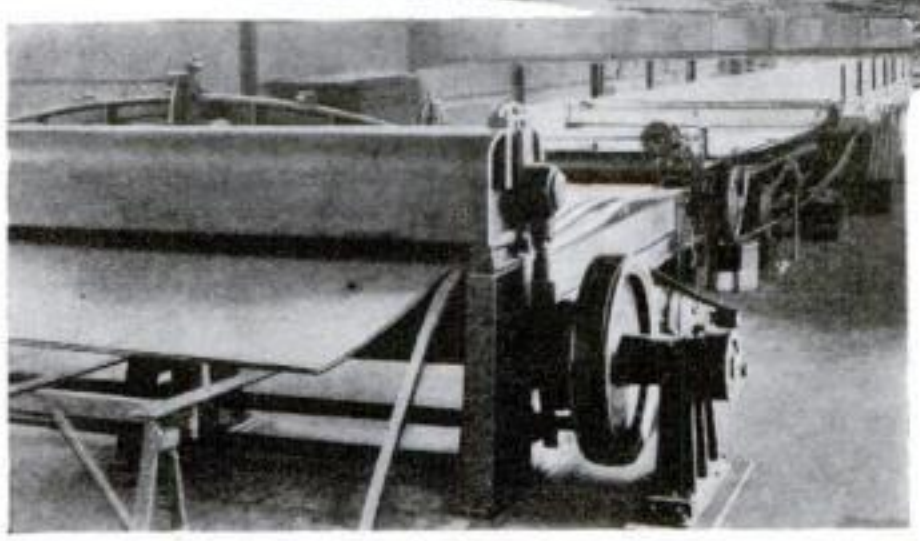
The chief of them is probably straw, including the dried stalks of wheat, oats, and other grains and containing fundamental chemicals similar to those in cornstalks. The same cellulose fiber is present, and paper or similar materials have been made from straw as rice paper has been made for generations in China and Japan. Oat hulls, chemically similar to oat straw, already have been put to use in making furfural by a bacterial process similar to the one possible on cornstalks and also on the other corn farmer's waste of dried cobs. Buckwheat hulls constitute another waste of the same kind, now unused. Still others are the pea vines, bean plants, dried pods, and similar wastes of these kinds of farming.

From all such strawlike materials well-known chemical processes can yield a rare sugar called xylose or "wood sugar." hitherto a chemical curiosity but with properties, the Bureau of Standards says, "which ought to make it a desirable material for use in the food, textile, and leather industries." The Alabama Polytechnic Institute is engaged on commercial-scale researches in the manufacture of xylose from peanut shells and the oilless residue of cotton seeds.

From straw of almost any kind chemical processes can prepare, it is reported, not only furfural and xylose but acetic acid like that present in vinegar, methanol or "wood alcohol," oxalic acid used in cleaning stoneware and plumbing, tar, illuminating gas, woodlike materials resembling those made from cornstalks, paper, and several kinds of wall board materials useful for absorbing either sound or heat.



Professor Sweeney used this cornstalk harvester in his experiments to show that this vast by-product is valuable.



These boards, nearly half an inch thick and capable of being sawed and nailed like wood lumber, are made of the despised cornstalks.

Among more specialized agricultural industries which already have utilized by-products successfully, an example is the pineapple industry of the Hawaiian Islands. When slices of fresh pineapple are prepared for canning much of the fruit must be pared away to remove the hard, scaly rind. The parings, although containing a great deal of good pineapple substance, formerly were thrown away as useless.

Some years ago a group of chemists and engineers headed by one of America's foremost food experts, Charles F. Ash of San Francisco, developed chemical processes for saving this waste pineapple. From it the industry now recovers vast quantities of pineapple syrup, sugar, citric acid, and other salable substances, materially increasing the income of the industry. If more by-product sugar and syrup are produced than can be used or sold, the excess is fermented with yeast and distilled to yield industrial alcohol.

The sugar industry is another that is saving its by-products. Waste molasses is fermented to yield alcohol. Fiber from the waste sugar cane is made into wall board, heat-insulating material, sound insulators, and so on, until these former by-products are said now to be more important in some regions than the sugar itself.

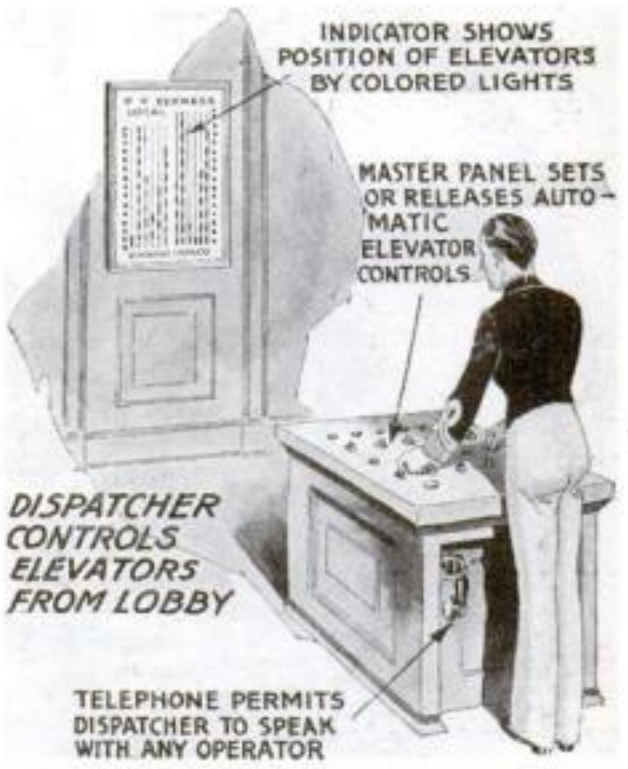
The cotton industry now makes use of its by-product cotton seed; oil and a compressed cake useful for stock food or fertilizer being the chief salable materials. Recently the short cotton fibers or "linters," which adhere to the seed when cotton is ginned, have found use as one of the raw materials for rayon. The dairy industry now uses the casein, once thrown away in skim milk, to make plastic materials resembling hard rubber. The tobacco industry uses waste stalks and coarser leaves as a source of nicotine, turned back to agriculture as an insecticide.

In the food canning and preserving industries the hard seeds of peaches, apricots, and sim- (Continued on page 159)

Modern Hotel is a Huge Machine

A Glimpse at the Mechanical Servants That Perform Superhuman Tasks Hidden from the Sight of Guests

By ALDEN P. ARMAGNAC



Express elevators in the New Yorker rise 700 feet a minute and automatically stop at signal.

SIX o'clock in the evening. New York's forty-three storied hotel—the highest in the world above the street and the deepest below—is preparing to open its doors to the public at midnight. An army of workmen complete last minute jobs, engineers and managers hurry through the corridors.

A flash and a sputter. Trouble on the sixth floor. A whole panel of electric fuses has blown out. Half the building is plunged in darkness. And only six hours before the opening.

Telephones jangle in the chief engineer's office. Every electrician in the house is up to fix the break. Cables have burned off and dropped out of sight down conduits. "Can't be fixed in less than three days," is the verdict. But this is a time when the impossible *must* be done. Ten o'clock, and they are fishing for the cables by the light of flashlights. Eleven o'clock, and the first guests are arriving. No time to trace connections. "Splice them on to any power line!" comes the order. Twelve o'clock the entrance doors swing open. The hotel is flooded with light. It took three days' work to straighten out the connections later—but on its opening, the New Yorker Hotel was lit.

Its chief engineer, Warren D. Lewis, faced me over a desk in his subterranean office. I saw a keen, alert face, a firm chin. Brown hair, tinged with gray. Blue eyes, a little tired, it seemed, behind thin gold-rimmed glasses. His job was to get the hotel's machinery going, and keep it going.

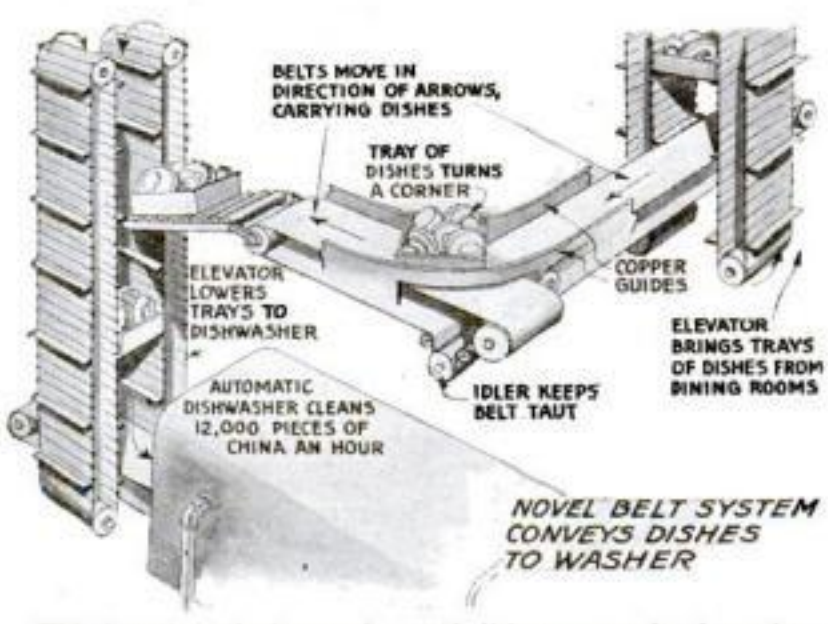
The New Yorker Hotel, probably the most-mechanized hotel in the world, is a "vertical village" that can hold 5,000 inhabitants. It has 2,500 guest rooms—only the Stevens Hotel in Chicago, with 3,000, has a greater capacity. Erected so recently, the hotel was able to take advantage of the last word in mechanical equipment—competent, superhuman servants unseen by the guests. They are buried, mostly, in four underground floors, like the machinery behind the scenes of a modern theater.

I had already passed through an impressive lobby and descended winding staircases, so many that I lost count, to reach the office of the chief engineer in the fourth basement, seventy-eight feet underground. Through its windows, I saw what looked like the engine room of a great steamship.

Warren D. Lewis, chief engineer, in the power room of the hotel's independent lighting plant.

"I'll take you through the hotel," Lewis said. "We'll start from the bottom up."

Black cylinders with gleaming metal bands—those were the four steam engines in the hotel power plant, with flywheels tall as a man. They were coupled to dynamos. The hotel makes its own electricity for everything from lighting lamps in the guest rooms to cleaning carpets. More economical, they find, in the long run.



This ingenious device carries used dishes on overhead moving platforms to a machine that washes 12,000 pieces of china an hour.

What if the steam engines should fail, with no outside electric connection? A Diesel engine as big as a street car is ready for an emergency. Resembling a giant automobile motor, it has eight cylinders, and burns oil. It is the only completely independent power plant of its kind in the world. The Diesel was the hardest single piece of machinery to get into the building, the chief engineer said. It was lowered from the sidewalk outside, after a huge truck had brought it, by a portable derrick. A hole had been left in the wall to get it in.

The whole power plant, Lewis said, could supply a city of 35,000. "We built it plenty large enough," he said, "so that later we might use some of the power for other buildings on this block." Exhaust steam from the engines is utilized to heat the hotel.

The steam comes from four towering boilers, each as large as a banquet hall. "A man in evening clothes could fire them without getting a smudge," Lewis said. The firing is done by pressing buttons. One starts a blower and shoots a blast of pulverized coal into the boilers. Another blows the ash—a half gallon to a ton of coal—by compressed air into a truck waiting outside. No dust, no men with shovels. Running the boiler in one of the world's biggest hotels is simpler than in the average home.

We climbed a circular staircase and zigzagged through corridors. The place is immense. "Many employees got lost," Lewis said, "just before the hotel opened. They would be sent out on a half-hour job and the boss wouldn't see them until next day."

"Stand back!" A traveling crane whizzed by on an overhead monorail track. From it dangled a sievelike metal drum, a "laundry basket," holding several tons. We were in the largest electric laundry in the world. It had its first real test the day before the hotel opened. An enormous consignment of linen, 40,000 pieces, arrived in one batch

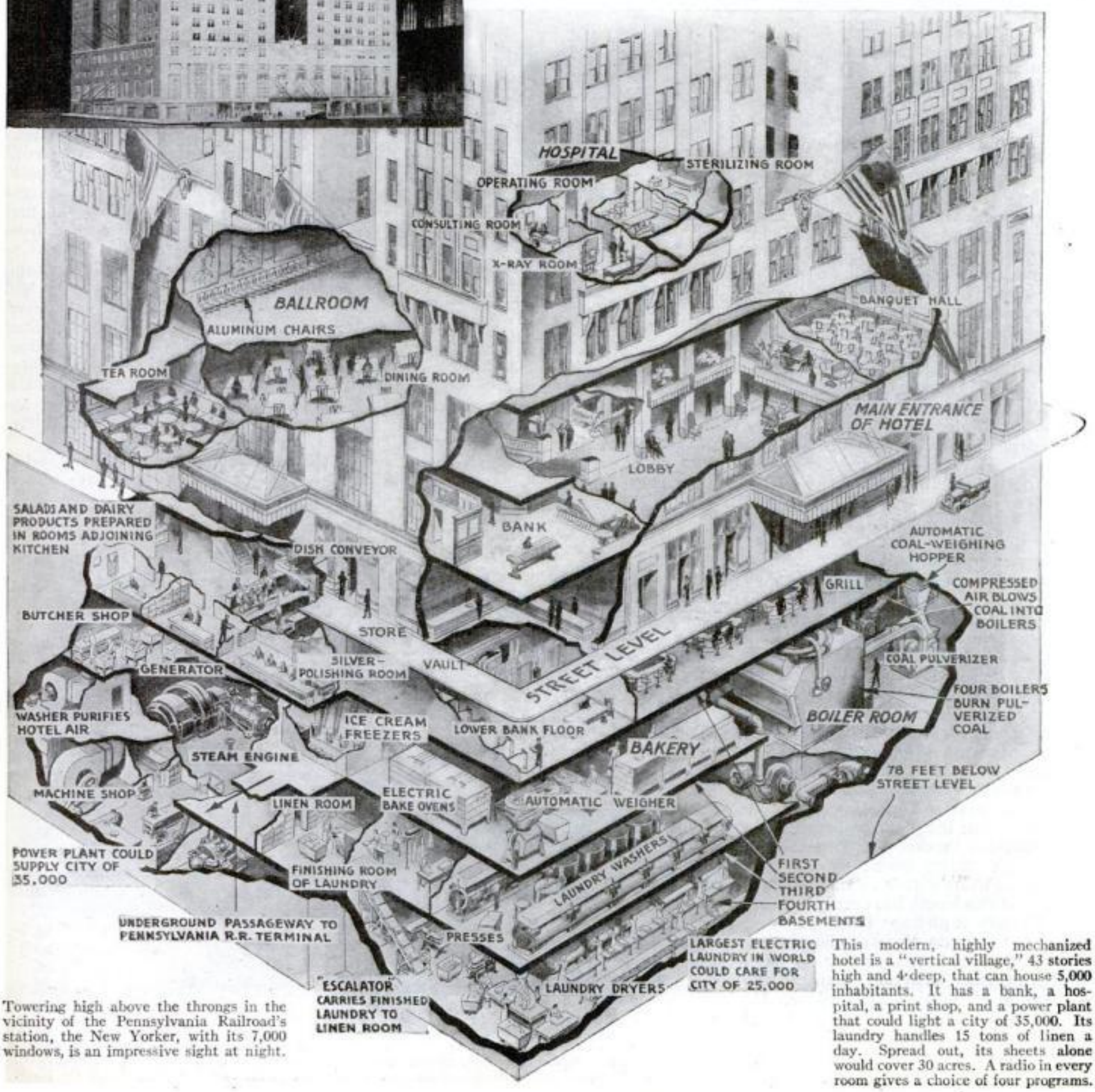
Towering high above the throngs in the vicinity of the Pennsylvania Railroad's station, the New Yorker, with its 7,000 windows, is an impressive sight at night.

at eleven in the morning—mostly sheets and pillow cases. All had to be laundered before they were used. Between one and two in the afternoon, the last piece was on its way up an "escalator" or moving runway that takes it to the linen room. In a working day the laundry can handle 130,000 pounds of linen—a little more than its daily requirements. Bed and table linen make a hotel's wash enormous. The New Yorker's 52,000 sheets alone would cover thirty acres of ground.

Through an open door we saw busy chefs cooking on the kitchen's thirty-eight sectional gas ranges. In the bake shop was an automatic weigher, measuring out ingredients from a hopper behind two electric ovens. We ducked beneath an overhead chute of gleaming copper. Trays of dishes glided along it, propelled by some unseen force, on their way to the dishwashing room. They switch around corners through an ingenious system of moving belts and enter the dishwasher—a metal contrivance eight feet long that handles 12,000 pieces of china an hour.

"Diners don't know what work goes on behind the scenes so that they may eat," Lewis said. "There's even more to it than this. A couple of unsung heroes worked fifty hours without sleep, not long ago, printing menus in the print shop".

Emerging from the basements, we paused in the lobby. In a space surrounded by elevators marked "Local" and "Express," an employee manipulated buttons on a control stand. He dispatches the elevators as a train dispatcher controls railway trains. Forty-three stories of "vertical traffic," as (*Continued on page 141*)



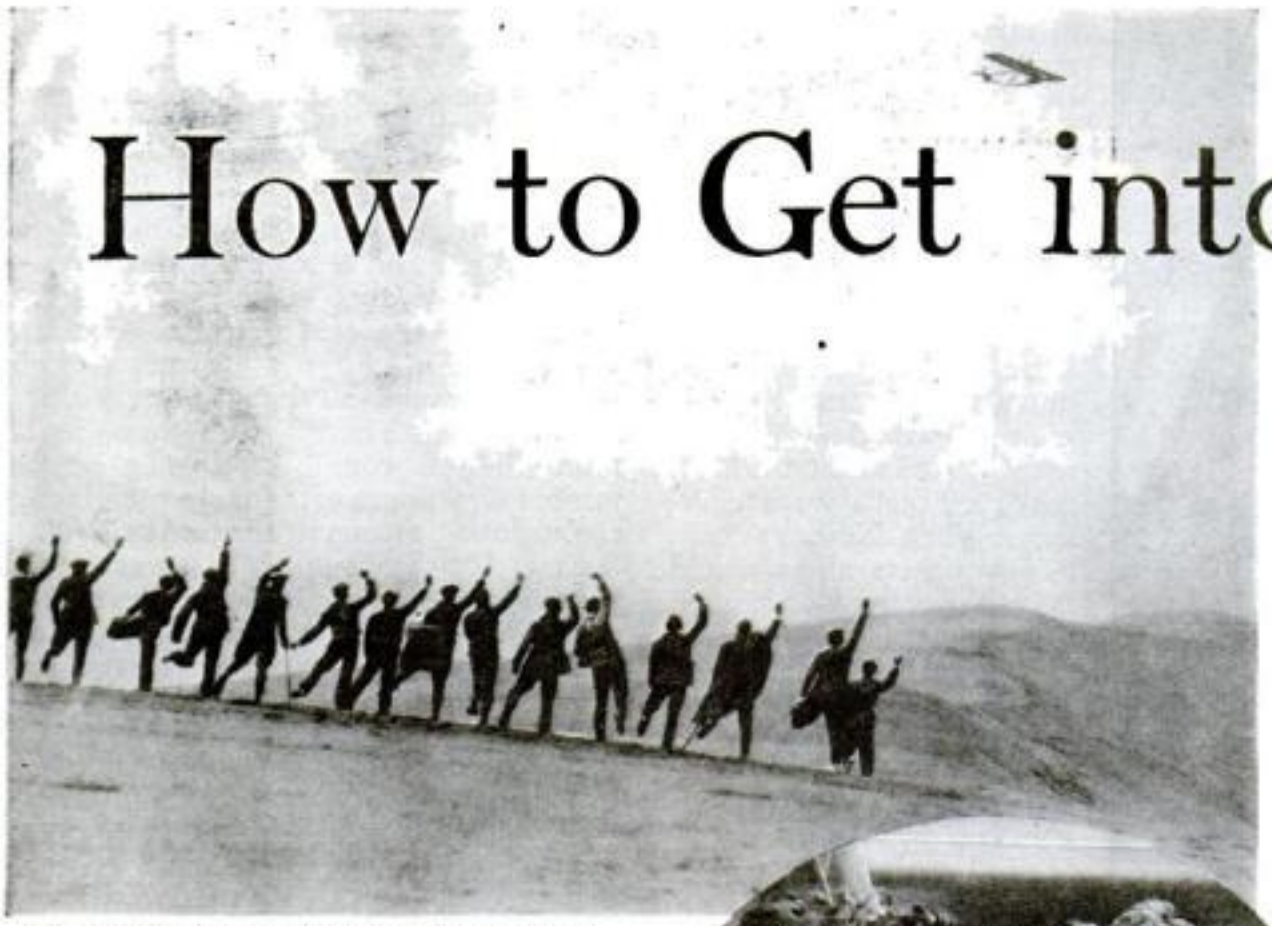
This modern, highly mechanized hotel is a "vertical village," 43 stories high and 4 deep, that can house 5,000 inhabitants. It has a bank, a hospital, a print shop, and a power plant that could light a city of 35,000. Its laundry handles 15 tons of linen a day. Spread out, its sheets alone would cover 30 acres. A radio in every room gives a choice of four programs.

How to Get into Gliding

Why the thrilling sport of motorless flying is sweeping the country and how you can get started in this great game. The equipment you need and what it costs; how to go about organizing a club.

By

EDWIN W. TEALE



The "call of the crane" greets a pilot at Rossitten, Germany, as he passes tests for a license.

ON SIXTY-FOOT wings, a human gull, W. Hawley Bowlus of San Diego, Calif., the other day soared over the California sea coast for more than six hours. His long ride on the air currents set an American endurance record for motorless planes. Bowlus, who built his own ship, is the ace of American glider pilots. Four times in recent months he has advanced the endurance mark until it now stands more than two hours beyond the four-hour-five-minute mark made in a German sailplane on Cape Cod, Mass., by Peter Hesselbach in 1928. In his honor, the San Diego enthusiasts have named their organization the Bowlus Glider Club.

Shortly after the new record was set, Col. Charles A. Lindbergh and Mrs. Lindbergh both won first-class glider pilot's licenses by soaring more than five minutes near San Diego in Bowlus sailplanes. Lindbergh's license is number nine; Mrs. Lindbergh's number ten.

The first man to obtain a first-class license in America was Lieut. R. S. Barnaby, of the Navy, who recently cut loose from the *Los Angeles* at Lakehurst, N. J., and spiraled down 3,000 feet in a glider to a safe landing. Within a few weeks, Captain Frank M. Hawks announces, he will begin a double transcontinental glider flight. His machine will be towed behind an airplane, starting and ending the flight at New York City. At every important city along the route from Los Angeles to New York, Hawks plans to cut loose from the plane and glide down to demonstrate the ease of motorless flying.

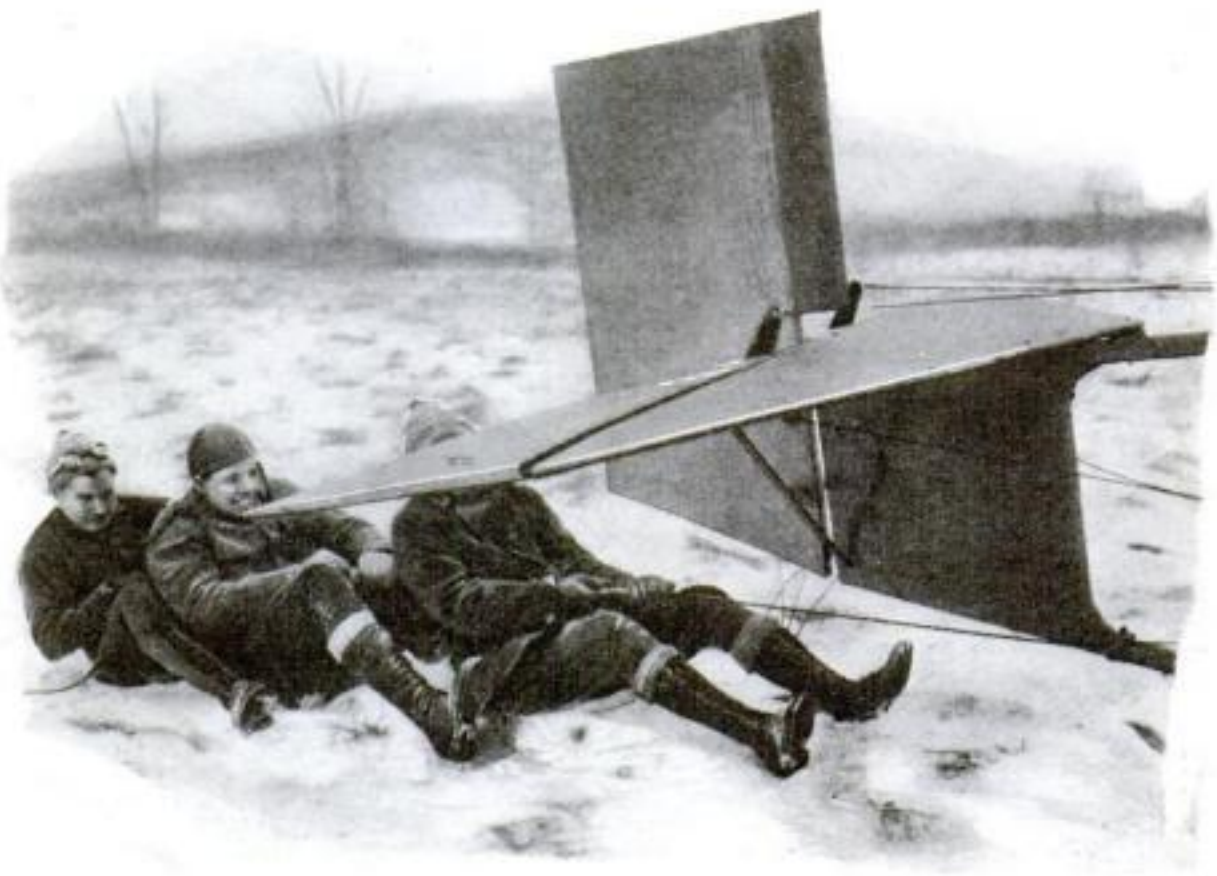
Although gliders towed by airplanes have made short flights in this country, no flight of this length has ever been made in the history of gliding. It will be a new record for Captain Hawks, who already holds the speed records for nonstop flights in each direction between the Atlantic and Pacific in an airplane. He plans to arrive in New York at the end of his trip in time to participate in a two-day carnival of motorless flying at Bayside, New York.

Colonel Lindbergh, right, gets his glider license and W. Hawley Bowlus congratulates him.

Meanwhile Edward S. Evans, honorary president of the National Glider Association, is offering a prize of $3,000 to the first American to make a motorless flight of twenty hours over American soil.

A sidelight upon the recent rapid growth of the glider movement in America is contained in the following incident. When the first article of this series (P.S.M., Mar. '30, p. 19) was prepared, a few weeks ago, the official endurance record was one hour and twenty-one minutes. (Hesselbach's four-hour flight was not official.) When the first proofs of the story returned from the printer, this figure had advanced to two hours and forty-seven minutes, and when the magazine went to press, it had leaped to five hours and twenty-seven minutes. The number of clubs affiliated with the National Glider Association, when the article was written, was twenty-five. When the first proofs came back it was thirty, and when the magazine appeared on the news stands it was thirty-two.

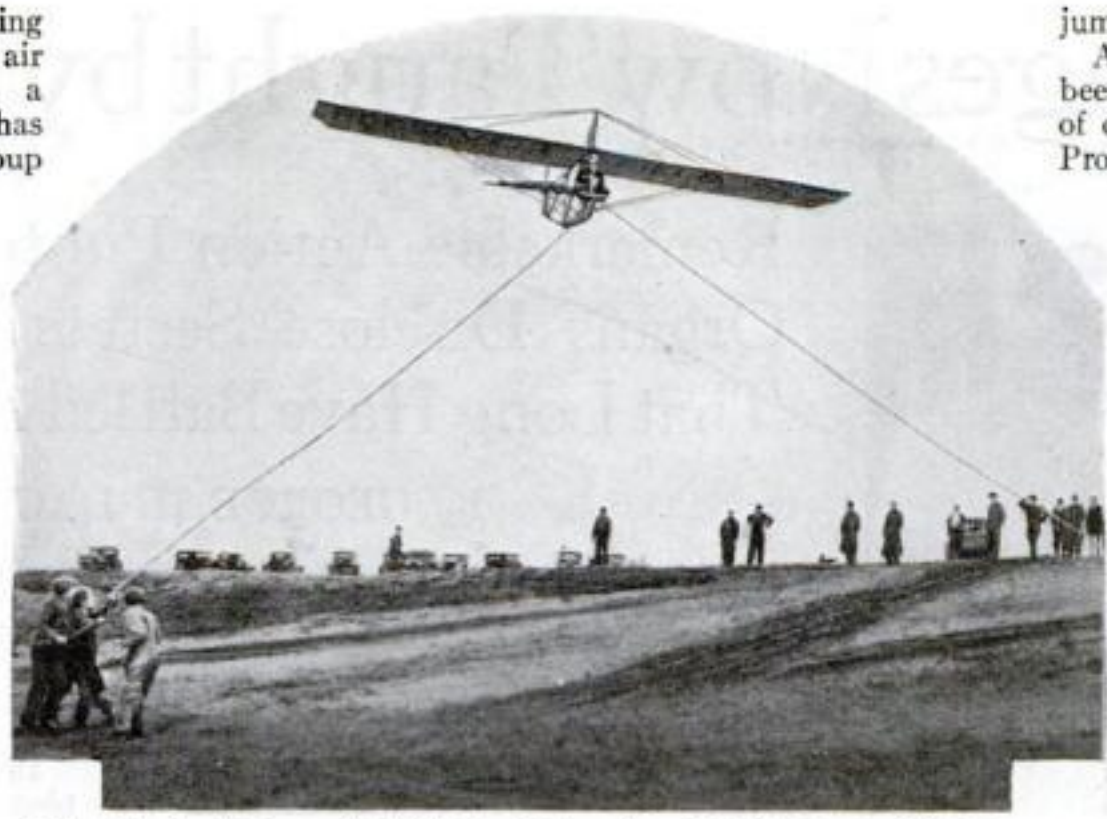
During coming months, many additional groups plan to purchase gliders



This is the way a glider is launched. Several men hold the rudder cord, while others are tugging at the shock cord in front. At the pilot's command these men let go the rope and away shoots the plane.

and to take up the thrilling pastime of coasting on the air currents. For gliding is a "social sport." That is, it has to be practiced by a group working together. One person cannot buy a glider and fly it himself as he operates a bicycle or an automobile. To launch the machine from hillsides requires the help of several people. This is why clubs, sharing labor and expense, make the greatest progress. In Germany more than 200 such clubs are in active existence.

Where can I get a glider? What will it cost? How shall I go about organizing a club? What kind of country is needed for gliding? These are the questions most frequently asked by those who want to get into the gliding game.



Up in the air at Roosevelt Field, New York where Heinrich Knott, Chief Instructor of the American Motorless Aviation Corp., shows students how to launch a glider.

As to the first question: The National Glider Association has made a survey of the manufacturers of motorless planes in all parts of the country.

THE products of a dozen of these companies, located in Michigan, Ohio, Kansas, New York, Massachusetts, California, Oregon, and Washington, are endorsed by the Association. This list of manufacturers is on file at the offices of Popular Science Monthly and will be sent to any reader upon request. One manufacturer plans to build a thousand gliders this year. These training planes will be constructed with interchangeable parts so repairs and replacements can be made easily. Complete parts, ready to assemble into finished gliders, will also be sold by some companies.

The cost of a practice glider varies. The average is about $400. Delicate soaring planes often run in excess of $1,000. An increased demand and mass production undoubtedly will result in a reduction of these prices. When glider parts are purchased and assembled by club members, the materials cost about $150. Expert workmanship is required to build a safe and successful motorless plane, and it should be attempted only under the supervision of a licensed mechanic, pilot, or airplane builder. The shock cord, a rubber cable about seven eighths of an inch thick, which is attached to the nose of the glider and stretched out by running men to launch the machine from hillsides, costs between twenty-five and forty dollars.

A CABLE of good grade should be secured, as an inferior one may deteriorate and break under strain. A broken shock cord has the kick of a mule and may seriously injure the pilot sitting in the glider for the take-off.

When a glider is purchased, a store of repair parts should be obtained also to save delays later in taking care of small accidents. Many gliders make from 500 to 800 flights without even breaking a wire. One machine, at the University of Michigan, has a record of 6,000 flights. Though it has been frequently patched and repaired, this veteran "puddle-jumper" is still in active service.

A unique practice room has been added to the equipment of one club in Massachusetts. Propellers blow air toward a stationary glider from different sides, giving the operator practice in maintaining balance without leaving the ground. Other clubs have anemometers mounted at practice fields to determine the velocity of the wind. For practical purposes, however, a bunch of dry hay will tell a glider pilot all he needs to know about wind velocity. The rule is: if a handful of hay dropped from a height of five feet is carried more than ten or twelve feet before hitting the ground, the wind is too strong for practice hops.

A Glider Pilot's Logbook, for keeping individual records of flights made, may be obtained free from the headquarters of the National Glider Association, Detroit, Michigan.

IT PROVIDES for entries such as: Date, Hour, Location, Type of Terrain (that is, the height of the take-off hill and the character of the surrounding country), Wind Velocity, Wind Direction, Type of Glider Flown, Method of Launching, Duration, Distance, Altitude, Remarks on Unusual Features of Flight. A club which is a member of the Association may obtain official recognition for records set by its members and for the qualifying flights for pilot's licenses which they make. A contest committee, approved by the N. G. A., does the official timing. A thirty-second hop straight down a hillside qualifies a flyer for a third-class license. A one-minute hop, with a complete right, left, or "S" turn, is required for a second-class license; and a five-minute soaring flight above the starting point for a first-class license.

At German gliding schools, when a student passes the time necessary to win his license, all the spectators give the curious glider salute, "the call of the crane." They stand on their right legs, stretch forth their left hands and imitate the bird's note. This same salute is accorded pilots who land with new records.

When a club has twenty or more members, the initial expense to each is slightly more than twenty-five dollars. Frequently local organizations aid groups to get started in gliding. When six or seven University of Michigan students, a few years ago, decided to form a motorless flying club, they had little money. They presented their plan to the Exchange Club of Detroit, which raised $600 and bought their first glider for them. The organization has now grown until it has

(Continued on page 152)

At left: Pilot is strapped in the glider's seat, ready for the take-off. Above: Illustration shows the right way to hold on to the shock cord while stretching it to launch the plane for flight.

Languages Now Taught by X-Ray

Remarkable Action Photos of Vocal Organs Disclose Secrets of Speech That Long Have Baffled Anatomists

By GEORGE H. DACY

Pneumograph makes needle record on cylinder of breath expenditure for vowels and phrases in many languages.

A GOLD chain many times thinner than a watch chain, a set of X-ray photographs, and a few ingenious devices have just solved secrets of human speech that have baffled anatomists for centuries. The photographs on this page are of human subjects talking a foreign language. The chain which appears as a white line in the center picture is one swallowed by the subject during the tests. The pictures were made under the direction of Professor C. E. Parmenter, of the University of Chicago, an authority on romance languages. They reveal for the first time just how the voice organs form consonants and vowels. Incidentally, these new tests show that the average American never masters a foreign language simply because he is too lazy to open wide his soft palate, the drooping muscular fold at the rear upper end of the mouth.

This remarkable X-ray photograph shows position of the vocal organs in uttering the French "a". The white streak is a gold chain swallowed to help identify them on plate.

Although the results of Professor Parmenter's experiments interest all voice experts, they were undertaken in the hope of finding a new and more effectual way to teach students foreign tongues. He had found, for instance, that no American could learn French perfectly simply by the customary practice of imitating native Frenchmen. Therefore he sought to learn the actual position of the voice organs so that he could teach students the correct lingual "stance" for any consonant or vowel.

Little was known about the operation of the vocal organs. No one had actually seen them in action. So Professor Parmenter made a number of X-ray pictures —the only collection of its kind in existence. Subjects were asked to pose with the head in a rigid, though comfortable, frame, and while they pronounced an "a" or an "f" X-ray pictures were taken. Diagrams traced from the life-size pictures showed the correct position of speech organs, both for English and foreign words. A tiny, flexible gold chain which the subject swallowed helped reveal the position of each organ, including the soft palate.

Besides the X-ray machine, Professor Parmenter has adapted several other scientific devices to help him in his work. One of the first he used records the rise and fall of the human diaphragm in speaking. At the detecting end of this device, called a "pneumograph," two belts fasten snugly about the chest and abdomen of the speaker. A mechanized bookkeeper, consisting of a revolving cylinder recording the movement of the diaphragm by a needle point on a smoked sheet, is connected to the belt by tubes (P.S.M., May '28, p. 49).

Breath, the basis of all speech, is measured by a novel piece of apparatus called a "kymograph." It consists of a mouthpiece, like a megaphone, into which the subjects talks. Rubber tubes connect it with a paper bellows hood, which expands or contracts with the amount of breath expended. The hood, in turn, is linked to a smoked plate recorder which accurately registers the phonetic results of each test.

In other studies a radio microphone, a set of special mirrors, and a standard motion picture camera are adapted to photograph the vibrations which constitute speech. Fluctuations of current generated by the voice in the "mike" vibrate the mirrors, on which the camera is focused. The films are enlarged and analyzed under microscopes to determine voice defects and their remedy.

IN ADDITION to studying these pictures and comparative drawings, language students "listen in" on phonograph records made by expert linguists in foreign tongues—and then attempt to repeat the words correctly into a dictaphone. Comparing the two records, a student recognizes and corrects his own mistakes.

A profile mask inside the box holds the subject's head in a rigid position while X-ray photographs of his speech organs are taken.

Explore Weird Island of the Dead

More than 600 of these huge images in stone have been found on the slope of Rano Raraku, and other parts of Easter Island. Who made them, when, and why is a mystery to scientists.

Scientists plan to invade mysterious Easter Island in an effort to solve the secret of its stone images, carved centuries ago by a forgotten race. Who were the strange men who lived on this most isolated spot?

By

MICHEL MOK

TO FIND the answer to a riddle that has baffled science for two hundred years, a group of twenty scientists from the University of Pennsylvania will go next spring to Easter Island, a mysterious pin point of land in the middle of the South Pacific.

Though populated by a handful of natives, it is primarily an island of the dead. In a nearly unbroken line, a series of monumental burial platforms stretches around its rugged coast, a gigantic stone memorial wreath to the forgotten great of a forgotten race. Nobody knows what kind of people built them nor when they were constructed.

More than 2,000 miles off the Chilean coast, its nearest island neighbor 1,000 miles to the west, Easter Island—a triangular fragment of volcanic land only forty-five square miles in area—is the most isolated inhabited spot on earth and one of the least accessible.

So remote does it stand from established traffic routes that, when a Spanish ship failed to locate it following an earthquake in that region in 1922, it took months to correct the captain's report that the island had disappeared. Only a few explorers have visited the place. And what they discovered there constitutes one of the world's most interesting unsolved mysteries.

The enormous tombs, about 260 in all, some of them 300 feet long, fifteen feet high, and topped by terraces that in some cases measure 100 feet in width, are not the only startling feature of this mid-ocean graveyard of antiquity. Face down, like huge ninepins, more than 600 colossal stone busts lie scattered on the island. No one has discovered who carved them out of the volcanic rock—or why.

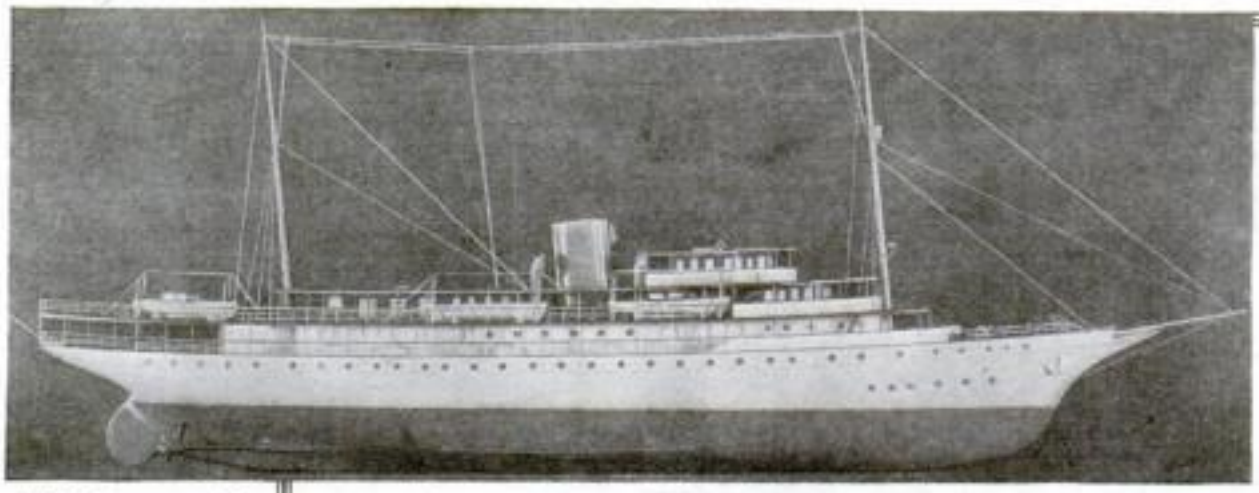
THE grotesque, solemn-visaged statues, the largest of which range from thirty to seventy feet in height and weigh from forty to 250 tons, were not always in their present position. There is every indication that many of them were used to ornament the burial structures, which are provided with large oval stone slabs for their support. A century and a half ago, one of the earliest seafaring men to view this strange marine mausoleum in a log entry expressed amazement at finding "the seashore lined with numbers of stone idols with their backs turned to the sea."

Why the images are no longer standing is pretty well known, but that is just about the only phase of the Easter Island mystery that has been solved so far.

How old are these monstrous figures? Their age has been estimated at from 2,000 to 5,000 years. Possibly, it may have been much longer. Were they idols, as the eighteenth century navigator thought, or the crude stone portraits of then-living chiefs or their illustrious ancestors? There are no satisfactory answers to these questions.

THE images were quarried inside the large crater of Rano Raraku, one of the island's three extinct volcanoes, whose ledges and slopes still are studded with scores of them, some completed, but many more in various stages of creation. How did their makers, doubtless ignorant of all but the simplest mechanical contrivances, manage to lower the immense statues from the crater's upper terraces to the bottom and then over the wall to the plain below?

Above all—what halted this vast



This is a model of the $1,500,000 yacht which will carry scientists to tiny Easter Island next spring. It will be equipped with a laboratory and also carry seaplanes.

Stranded in the midst of the Pacific, Easter Island is the world's most isolated inhabited spot. It lies 2,000 miles from Chile and 1,000 miles from nearest land.

undertaking? Rude stone implements have been found and to this day are lying on the mountain slopes and in the quarry, apparently just as the workmen left them centuries ago. This, and the fact that a majority of the images remaining in the quarry are unfinished, seem to show that labor was stopped by some sudden devastating force.

WAS it war, pestilence, famine? Or did a great catastrophe of nature blot out the busy scene and wipe out the workers?

Again, nobody knows, though guesses are not lacking. Earthquakes and volcanic eruptions have been advanced as probable solutions of the mystery, but there is little geological evidence to support them. Moreover, had such upheavals taken place, probably the figures and burial platforms would have been shattered or covered with lava.

The most romantic of the theories suggests that Easter Island, ages ago, may have been the highest ground, as well as the cultural and religious center, of a much larger island or perhaps even a vast continent, since submerged, like the more or less legendary Atlantis. Chief sponsor of this idea is Dr. J. Thoulet, veteran French oceanographer, who studied the currents and bottom conditions of that part of the Pacific in 1928. Though this is mere theory, translations of hieroglyphic inscriptions on ancient wooden tablets found on the island indicate that, at any rate, drastic climatic changes may have occurred there when the world was young.

To wrest the secrets from this prehistoric ocean mortuary, the University of Pennsylvania expedition will be elaborately equipped. It will set sail for the South Pacific as soon as a $1,500,000 motor yacht, designed especially for the purpose, is completed, probably in May, 1931. The 265-foot boat, the *Caroline*, one of the largest private Diesel powered vessels ever built in this country, is the property of Eldridge R. Johnson, a trustee of the University and former president of the Victor Talking Machine Company, who will sponsor the expedition and accompany the party to Easter Island.

Powered by two 1,500-horsepower engines operating twin screws, the *Caroline* will have a complete laboratory on her upper deck. She will carry deep-sea dredges as well as seaplanes in which to make reconnaissance over uncharted seas.

One of the age-old problems presented by Easter Island which the expedition, with its wealth of modern exploration paraphernalia, may be able to solve is the one of the origin of its inhabitants.

Where did these people come from and how did they reach this remote spot? Did they migrate from Chile or Peru, in South America, more than 2,000 miles to the east, or did they sail against the prevailing winds from the "nearest" islands of the Tuamotu Archipelago, about 1,000 miles to the west?

Legends of the Maoris record that they stopped at Easter Island on the way from Peru to New Zealand and erected the statues and burial memorials in conformity with a custom on arriving in a new land. This, too, would account for the unfinished condition of some of the images. No similar works, however, have been found in any known Maori settlement.

ONLY some 200 Kanakas are now living on the island. They know little about the marvelous mausoleum that is their homeland, and care less. Were the men who wrought the wonderful works the ancestors of the present inhabitants? Were they the Maoris or did they belong to a much earlier, vanished race? In any event, the Easter Islanders of today have not inherited their culture.

They live in Mataveri, the only village, near Cooks Bay on the southwestern coast, and tend the herds of sheep and cattle of a Chilean company that exploits the island as a ranch. The company's manager is the only white man in the place. A vessel with mail and supplies puts in about once a year.

With the exception of this small settlement, the island is virtually one big cemetery. Aside from the tombs, there are thousands of graves;

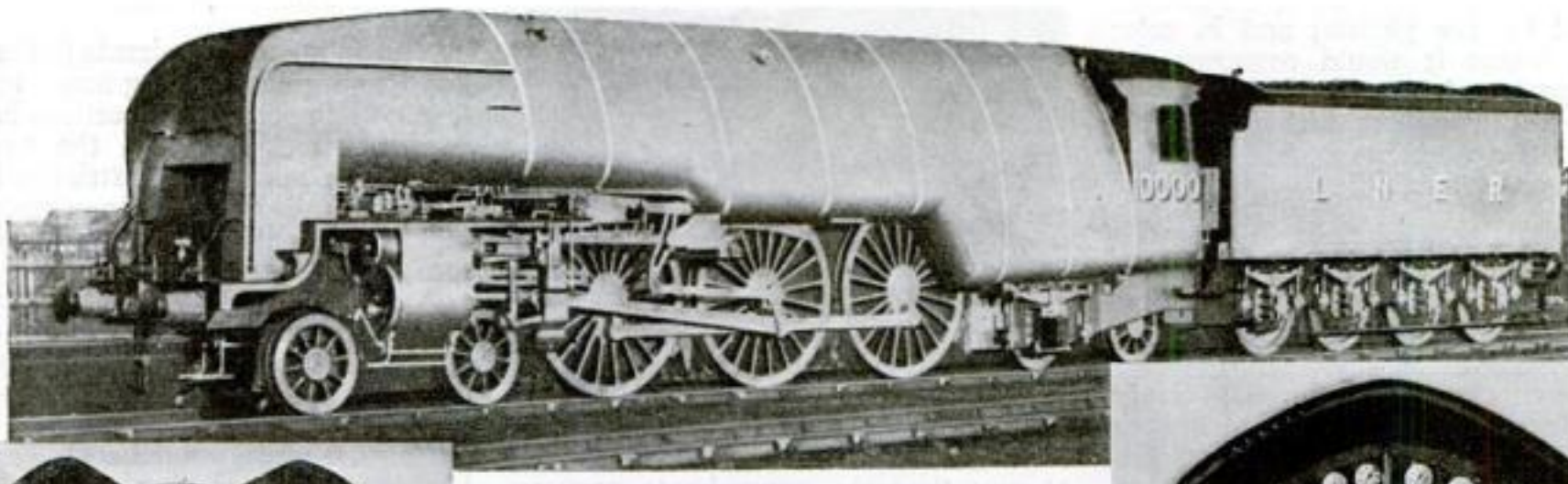
(Continued on page 157)

Courtesy of American Museum of Natural History

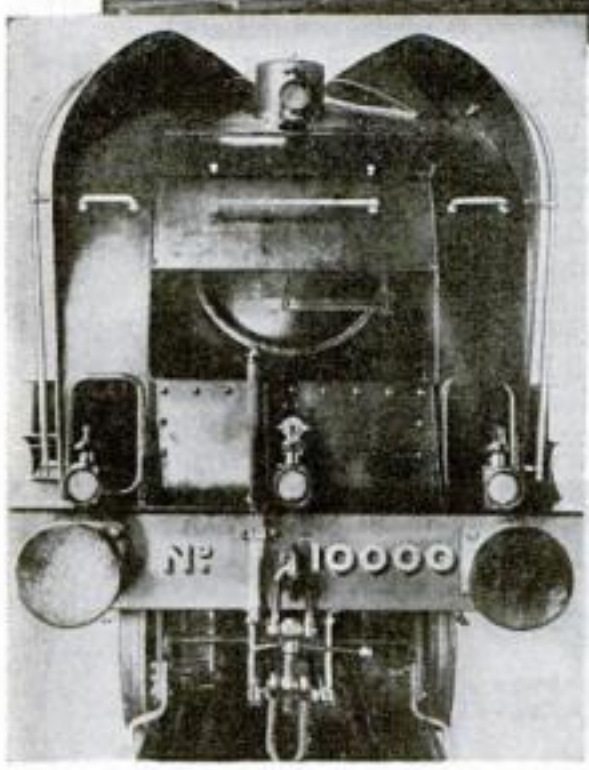
One of the seven ancient wooden tablets inscribed with hieroglyphics, found on mysterious Easter Island. Only two of them as yet have been translated.

NEW IDEAS AND INVENTIONS

On this and succeeding pages are described the latest achievements of inventors and novel applications of scientific progress



England's newest and largest express locomotive, showing streamline design and overhanging boiler.



Front view of the locomotive. Note how the stack is sunk in a depression along the top.

NEW BRITISH LOCOMOTIVE A STREAMLINED GIANT

LIKE a mammoth armadillo on wheels is the new British steam locomotive built for express passenger service on the London and Northeastern Railway, which can now boast the longest and heaviest locomotive in Great Britain. The novel "streamline" giant owes its peculiar appearance to the facts that the wide boiler overhangs the locomotive's drive-wheels on each side, and that the smoke-stack does not project above the boiler. The stack is sunk at the front of a central depression along the top of the boiler. This arrangement is said to throw the smoke clear of the driver's view. The streamline design was developed by testing a model in a wind tunnel, in air speeds up to fifty miles an hour.

Unusual features distinguish the engine from its predecessors. It has an unusually high boiler pressure of 450 pounds per square inch, the ordinary pressure for British locomotives hitherto being 200 to 250 pounds. The object of the high pressure is fuel economy. Another feature is that the entire air supply to the fire grate is preheated.

Mechanics working at the Darlington shops where the locomotive was constructed called it the "hush hush" engine because of the extreme secrecy attending its birth. After preliminary trials, it will soon be tested out on the London-to-Edinburgh service.

LOWER OBSERVATION CAR FROM ARMY DIRIGIBLE

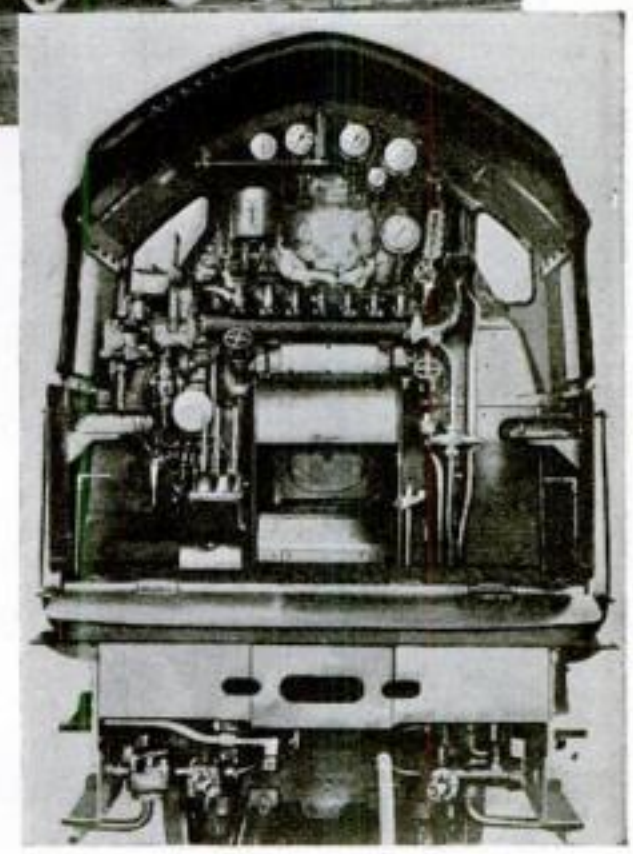
A DIMINUTIVE car carrying an observer swung hundreds of feet below a flying airship above Langley Field, Va., in a recent Army Air Corps test of a newly-applied device for seeing through the clouds. It was believed to be the first successful try-out in America of this method, first applied in German dirigibles on bombing raids, of directing an airship's flight while the airship itself flew above the clouds, out of the sight of persons on the ground.

The car used in the Army test is a small cabin hung by a cable from the dirigible. Like the German models, it is lowered and reeled in while the craft is in flight. The observer in the car directs the ship's maneuvers by telephone, made possible by a core of telephone wire in the supporting cable. For emergency a mechanical signaling device is provided.

Use for the device, Army officers say, may include not only directing bombing operations, but also making close-up photographs of enemy positions while the dirigible flies unseen. For peace-time use, it may assist dirigibles landing in fog. The device was developed by the Materiel Division of the Army Air Corps at Wright Field, Dayton, O.

"BOMB" DROPS FREIGHT FROM AIRPLANE

WHEN the precision clockwork within a new bomblike container is set, it may be dropped from a plane flying at heights up to 6,000 feet and a parachute will open and lower it gently to earth. The device, a Swiss invention, is intended to facilitate the delivery of goods by air freight. It comprises a cylinder of aluminum, in which the materials to be delivered are placed, and an attached container which releases the parachute.



This rear view shows the interior of the engineer's cab, with controls and instruments.

The clockwork to open the parachute is set according to the altimeter. A special dropping gear provides for the release of five of the cylinders from a single plane.

NEW LENS INVENTED FOR PANORAMIC MOVIES

THE same laws of optics that make a tall man into a squat pygmy when he observes his reflection in an amusement park mirror are put to work in a new French lens for motion picture cameras. It simplifies the making of films for the newly-popular movie screens of double width, since it permits the use of standard movie film instead of the double-width film used in America. The result is economy in film and in the amount of special apparatus required.

More cylindrical than circular in form, the new lens squeezes twice the usual width of view into a standard-sized picture, although vertical dimensions are undistorted. When the film is projected

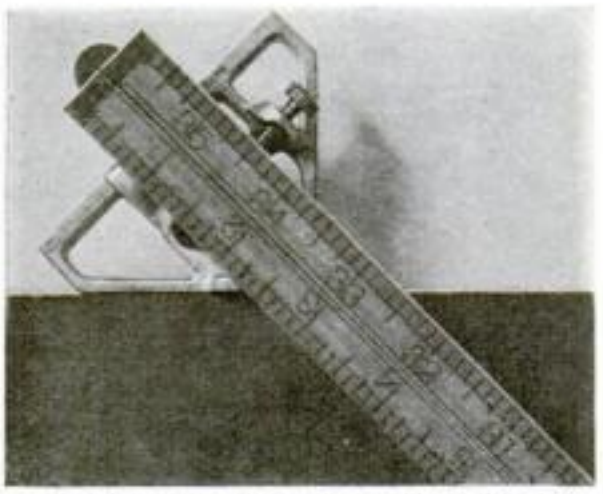
a similar lens is used to throw it on the screen. The projector lens thus "undistorts" the picture and the result is a clear photograph of normal height and of twice-normal width.

Other possible applications seen for the novel lens are in making talking movies, where the lens would save film by allowing the part carrying the sound record to encroach on the space usually occupied by the picture; and in color movies, where it would compress the triple number of pictures required into a normal length of film, with advantages in economy and in avoiding "color fringes" around rapidly moving objects.

TOOL COMBINES SQUARE, GAGE, PLUMB, LEVEL

A COMBINATION tool of extraordinary compactness and many uses has been devised for carpenters and home woodworkers. Used in conjunction with an ordinary carpenter's two-foot rule, it is convertible into a right- and a left-hand bevel square, a compass, and a try-square. It also serves as a plumb and a level, or an inside square and a depth gage.

The device is a small frame of aluminum in the shape of a right angle triangle and provided with a clamp that grips the folded carpenter's rule in a position at right angles to one of the sides of the triangle, and at an angle of forty-five degrees to each of the other two sides. Thus it serves either as a try-square or



The triangular tool, used with a carpenter's two-foot rule, serves as a handy bevel square.

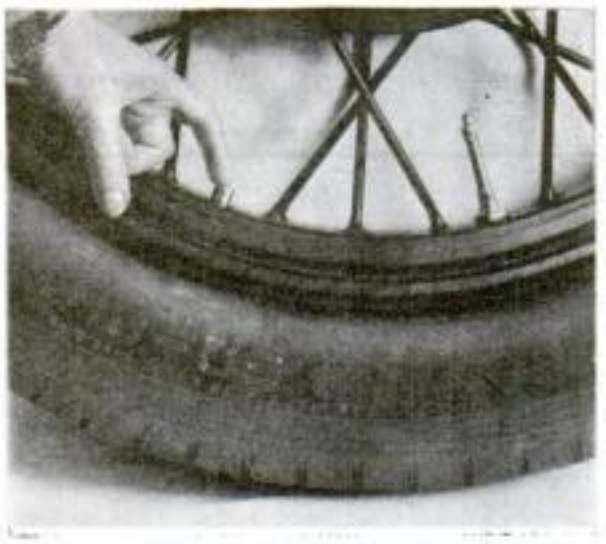
a bevel square, according to the side which is placed against the work. Since, in the try-square position, the rule can be adjusted to extend any distance within its limits from the edge of the tool, it can be employed as a depth gage and a marking gage.

The device holds a small bubble level which is exposed when the rule is removed. Without the rule, also, it serves as a small square for corners which cannot be reached with an ordinary try-square.

NEW CORE FOR CASTINGS

FOUNDRY practice may be made over by a new core for castings made of sand and surrounded by a rubber compound. Under the pressure of the solidifying metal, it eventually collapses, and the residue is poured out. Formerly it had to be chipped out.

HANDY PRESSURE GAGE FITS IN TIRE RIM



A NEW substitute for the ordinary tire gage carried by motorists is an air pressure gage which fits into the rim of the wheel. Resembling a tire valve, a red dot in its center moves up and down to tell at any time the approximate pressure within the tire. The little red dot is on the top of a rod which rises and falls within the gage. When the dot is flush with the top of the gage, the tire pressure is exactly right.

The new gage is inserted through the rim only, and does not enter the tire itself, but simply reacts to the pressure. To install it, the air is released from the tire, the tire and tube are pushed to one side, and a 3/8-inch hole is drilled through the rim.

STEEL BALLS NOW USED TO CARRY HELIUM

SIX steel balls mounted on a flat car constitute a novel helium container, recently developed for transporting the airship gas from Texas fields. Formerly elongated cylinders carried on flat cars were used for this purpose.

Because their shape permits twice the usual pressure to be applied to their contents, the spherical containers can carry twice as much gas as cylinders of the same volume. In a recent test one of the six-foot spheres, made of inch-and-a-half-thick steel, was filled with helium at a pressure of 1,250 pounds to the square inch, and run off a twenty-five-foot bank. It was unharmed. Later it exploded only when the pressure was raised as high as 4,500 pounds.

HARDEN STEEL BY NEW MAGNETIC PROCESS

MAGNETISM can be used instead of heat to super-harden metals, according to the recent discovery of E. G. Herbert, British metallurgist. Test specimens of steel which he hardened by subjecting them to magnetic fields of repeatedly changed polarity could not have been hardened more by special heat treatment, he reported to the Iron and Steel Institute.

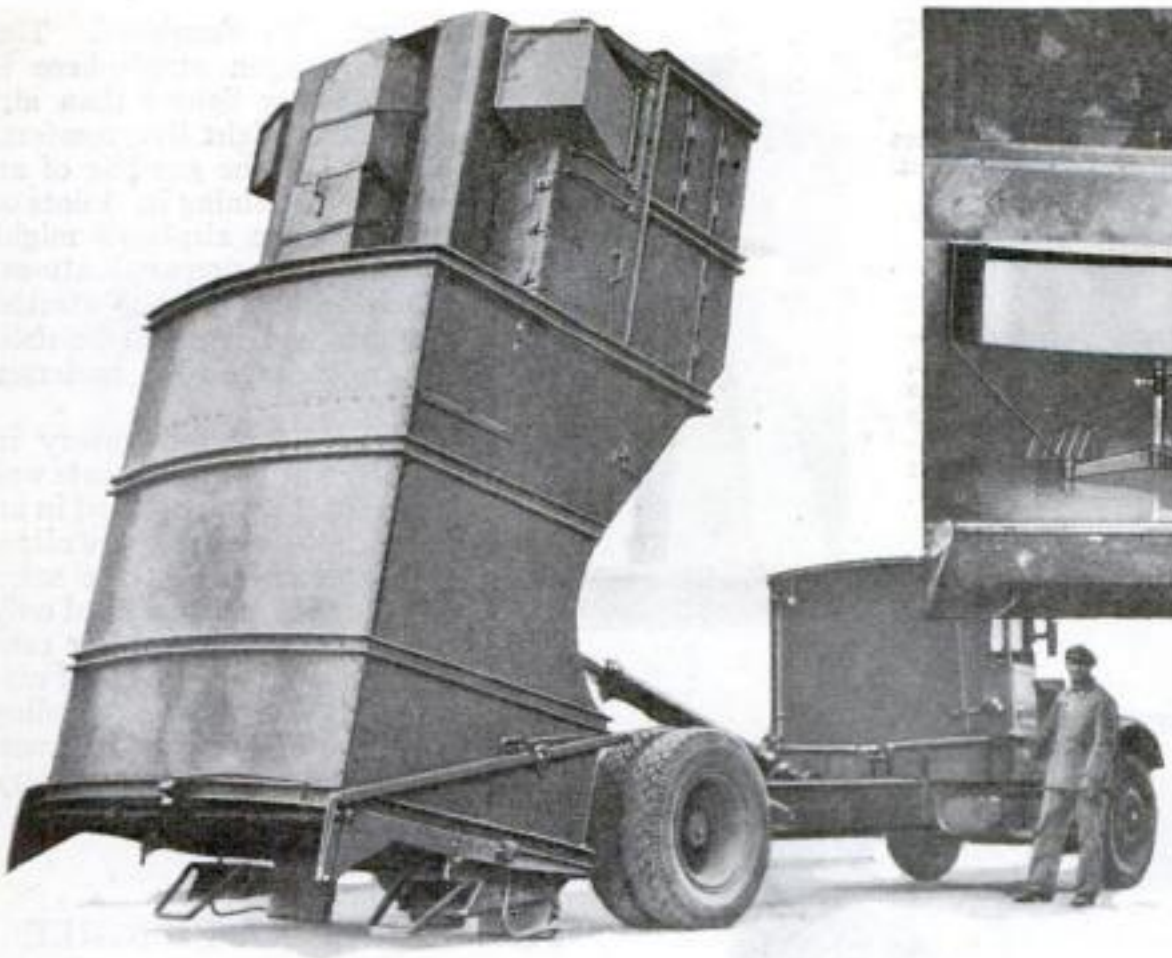
Whether the new way of hardening is of commercial value has not yet been determined. Evidently both heating and magnetic treatment subject the atoms of metal to the same action that results in the hardening process. The discovery may lead to new and important knowledge about the structure of magnetic metals, such as iron and steel.

NUMBERED KEYBOARD AN AID TO BANJOISTS

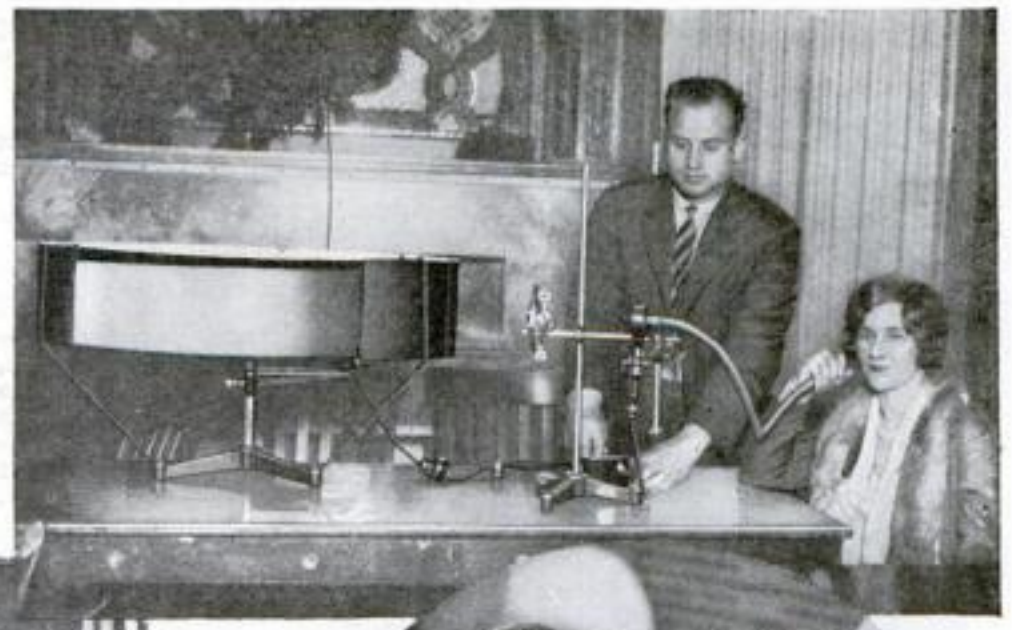
NO LONGER need aspirants to the art of banjo and guitar playing screw up their fingers to impossible contortions in order to strum melodies from the twanging strings. A new type of stringed instrument demands merely a knowledge of an index numbered from one to twenty-one for its production of chords.

A small compact keyboard made of Swedish spring steel fits over the neck of the instrument, containing a system of levers which press down on the strings according to the various chord patterns. There is a numbered key on the keyboard corresponding to each chord pattern. There are twenty-one keys altogether, all of them within easy reach of the fingers. If one wishes to play "Old Man River," for instance, he finds what numbers on his banjo keyboard correspond to the chords on the printed music, and then writes those numbers over each respective measure of the music. All he has to do then in order to play the piece is to press the keys of the corresponding numbers.

Pressing one of the numbered keys (shown under glass) automatically "fingers" a chord.



Sanitary Garbage Truck. To remove garbage and ashes without causing odor or dust in the streets, the city of Berlin, Germany, has introduced this special truck. Refuse cans are emptied into swinging receptacles at the front of the body. A hydraulic piston swings the body to a vertical position as shown, dumping the contents into it.



New Aids for the Deafened

The top photo shows a new "voice picture" apparatus demonstrated before the California Association for the Teachers of Deafened Adults. A light beam projects a "picture" of the deafened person's voice vibrations on a rotating screen, helping the subject learn how to control his or her intonations. In circle: Headphones plugged into the front pew enable the hard of hearing to listen to the sermon in a church at Berlin, Germany. The preacher's voice is amplified through a special microphone.

New Switch Controls High Voltages

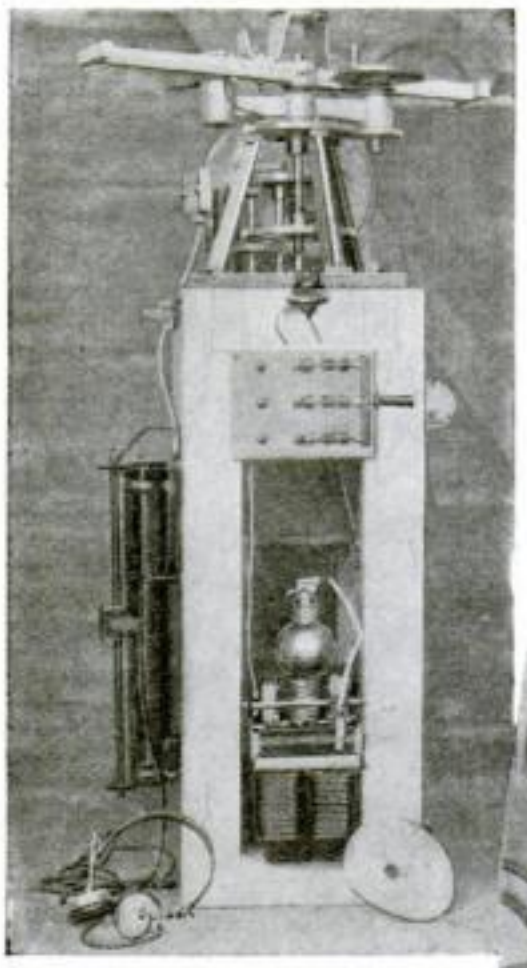
This compact new type of high voltage switch, encased in a vacuum chamber of glass, has been developed by Dr. R. A. Millikan and Prof. R. W. Sorenson of the California Institute of Technology to control the millions of volts used in laboratory electrical tests. Eventually it may be adapted commercially to replace bulky power switches.

Front-Wheel-Drive Truck

The front-wheel drive has been applied to the heavy motor truck in Germany. As pictured at the right, the engine is placed on a frame projecting far ahead of the front axle. The advantages claimed are economy of power in transmission and easy riding qualities.

NEW IDEAS AND INVENTIONS

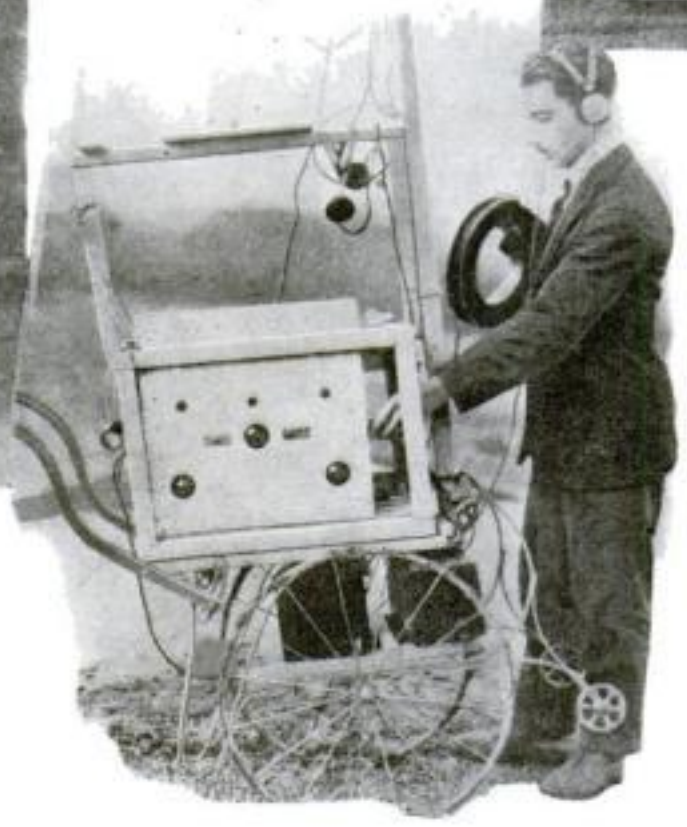
RADIO BEACONS FOR AIRPORTS



Transmitting apparatus that sends the radio beams from the airport.

At right: One of the two towers from which the signals are sent.

Below is the portable receiving apparatus which, placed in a plane, enables a pilot to follow the radio beam signals and so keep to his course. The photo shows the apparatus trundled on a small cart during a recent demonstration.



"RADIO roads," leading aviators through darkness and fog from airport to airport, will be part of the equipment of every skyway in a few years, according to William Loth, a French inventor, who recently announced to the French Academy of Sciences the perfection, after several years' work, of a novel type of radio beacon.

The beacon, similar in purpose to the ones successfully tried in America, sends out a constant radio signal in a straight line. Two of the devices are used at the same time, sending their signals out so that their beams form an angle with the vertex at the airport and the opposite end in the direction of the incoming plane. On the plane, a receiving instrument picks up the signals. The pilot, listening through ordinary headphones, hears the code letter T, a dash, as long as he keeps within the angle made by the two wave lines. This means he is headed on his correct course. If he swings to the left, he hears a warning signal, the repetition of the letter N, a dash and a dot. If he swings to the right, the signal is the letter A, a dot and a dash.

By observing the signals closely, the inventor says, an airman need not diverge more than a few feet from the exact course.

Loth is best known as the inventor of an underwater cable used to radiate impulses which can be picked up on board a vessel, thus leading it through narrow channels and into harbors.

A NEW COKE DUST FUEL

THE lessened chance of spontaneous combustion, an ever-present dread in connection with coal yards and even domestic coal bins, is one of the advantages of a new "low temperature" coke dust for domestic and factory use. The Pittsburgh experiment station of the Bureau of Mines of the United States Department of Commerce has found that the distillation of coal at low temperatures gives, besides a more valuable yield of oils and tars than is obtained by traditional methods of distillation, a type of coke which ignites more readily than the best grades of ordinary coke. Burned in the furnace as a coke dust, it is said to be smokeless. But in spite of its high igniting qualities, the dust can be stored away in bins with greater safety than ordinary coal, the Bureau states in its report.

MAKES "ARTIFICIAL AIR" FOR PLANES AND SUBS

NEW kinds of air, apparently as good or possibly even better to breathe than the sort provided by Nature, are the recent discovery of Dr. J. Willard Hershey, chemist of McPherson College, Kansas. Artificial mixtures which he has developed contain helium and oxygen, and may be applied in submarines or in high-altitude airplanes.

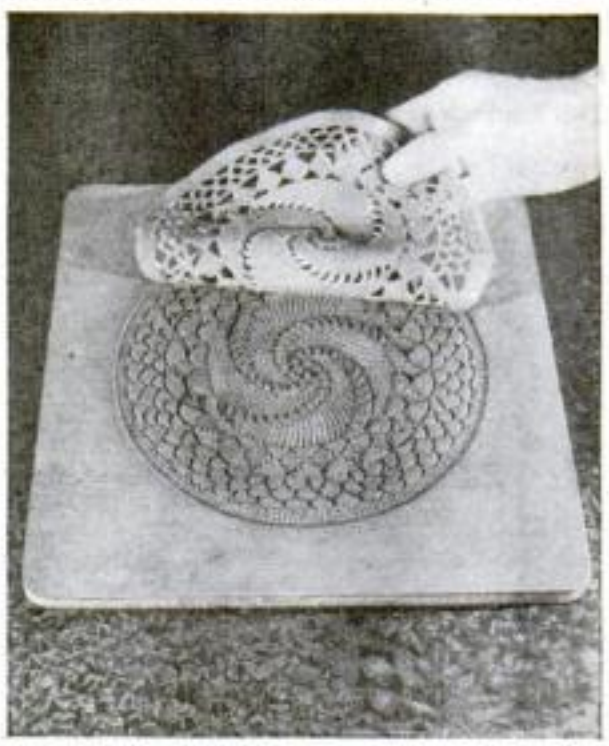
Natural air is one fifth oxygen and four fifths nitrogen gas. The oxygen supports life, while the nitrogen acts merely as an inert substance diluting the richness of the oxygen. By substituting helium gas for the nitrogen in about the same proportions, Dr. Hershey produced an artificial atmosphere in which mice and guinea pigs flourished. The helium-oxygen atmosphere is considerably lighter than air. A person might live comfortably inside the gas bag of an airship containing it. Pilots of high-altitude airplanes might breathe the prepared atmosphere instead of concentrated oxygen, and it might be used to advantage in undersea craft.

An incidental discovery in Dr. Hershey's experiments was the fact that mice placed in an artificial mixture of pure nitrogen and oxygen in the same proportions as in air li ed only a few days. Natural air contains about one percent of carbon dioxide and rare gases, including helium, argon, krypton, neon, and xenon; and these were shown to be necessary for life in a nitrogen-oxygen mixture.

PRINTING FINE FILIGREE ON RUBBER MATS

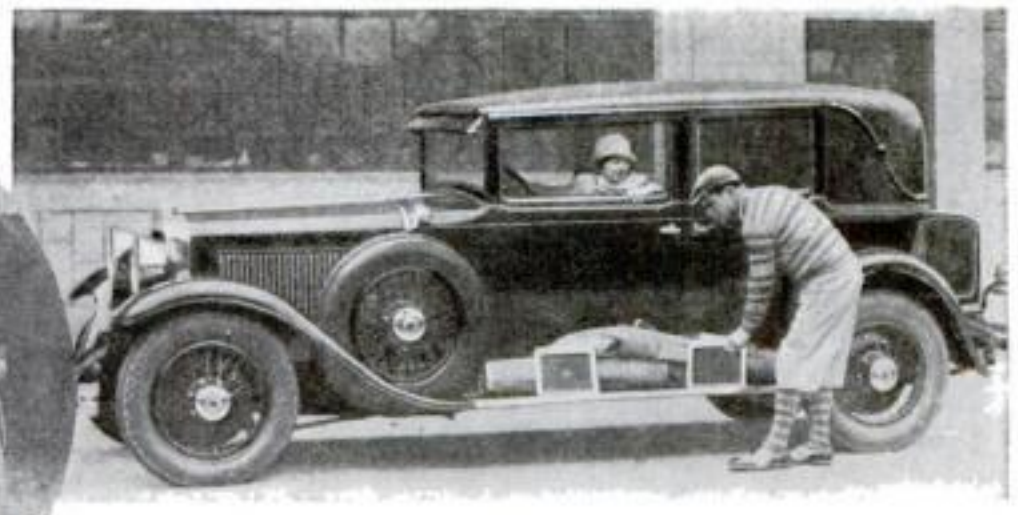
RUBBER bath mats, table mats, and similar household objects susceptible to decoration can now be enhanced with all sorts of fanciful designs and turned out at a low cost by a process patented by Glenn H. Willis, of Akron, Ohio. The objects are made of hard rubber and may have designs of lace, fabric surfaces, tree leaves, stone surfaces, toy outlines, or almost any pattern traced upon them.

The crux of the process is a hard rubber mold, cheap and durable. Hard rubber is simply ordinary rubber with a high percentage of sulphur. In the uncured state it is a soft, doughy mass. In making the mold of the Willis process, the object whose pattern is to be reproduced is placed in contact with a sheet (one half inch or so thick) of uncured hard rubber between the jaws of a steam-heated press. As the mass becomes heated it expands and flows into every nook and cranny of the "pattern" object. As curing proceeds, the mass becomes hard. When the rubber plate is cured, it is taken from the press and the pattern object removed. Various color combinations can be used to brighten up the finished product.



The complicated crochet pattern of a doily is reproduced in fine detail on a hard rubber mat.

A Limousine Side Car. This latest in motorcycle luxuries, exhibited in London, has an inclosed body with sliding roof and windows, leather upholstery, and dashboard conveniences. At the rear is a luggage compartment which locks.

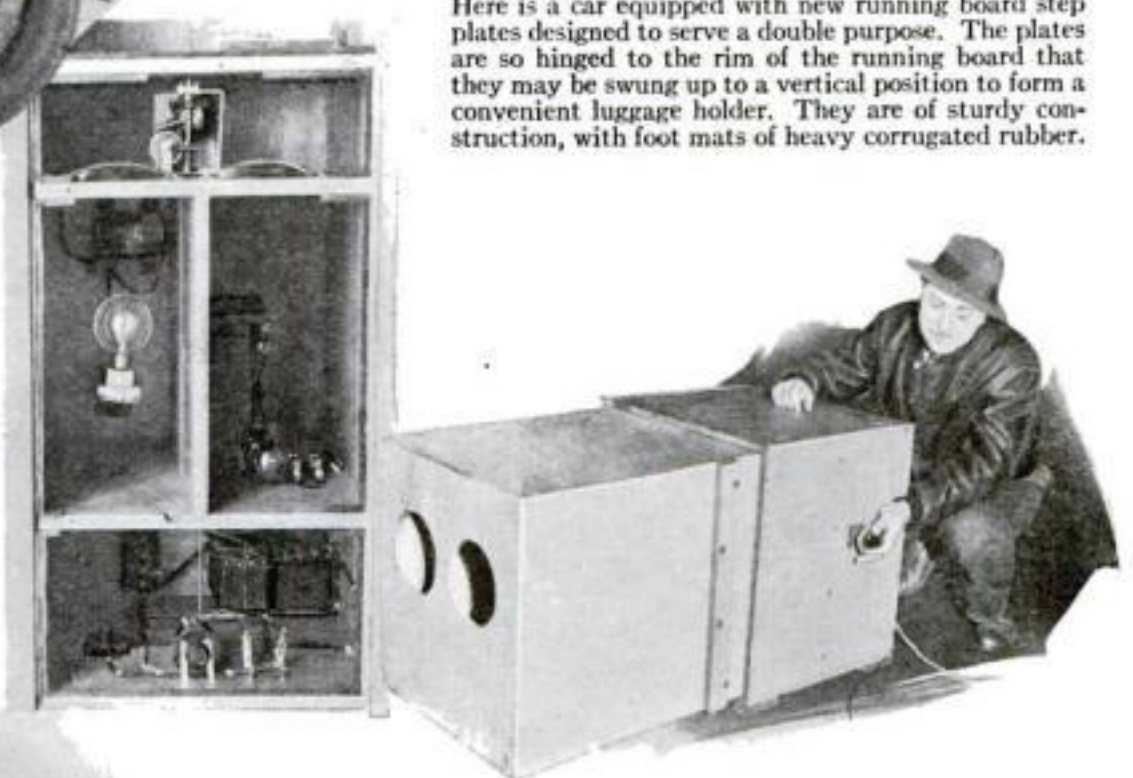


Step Plate Luggage Rack

Here is a car equipped with new running board step plates designed to serve a double purpose. The plates are so hinged to the rim of the running board that they may be swung up to a vertical position to form a convenient luggage holder. They are of sturdy construction, with foot mats of heavy corrugated rubber.

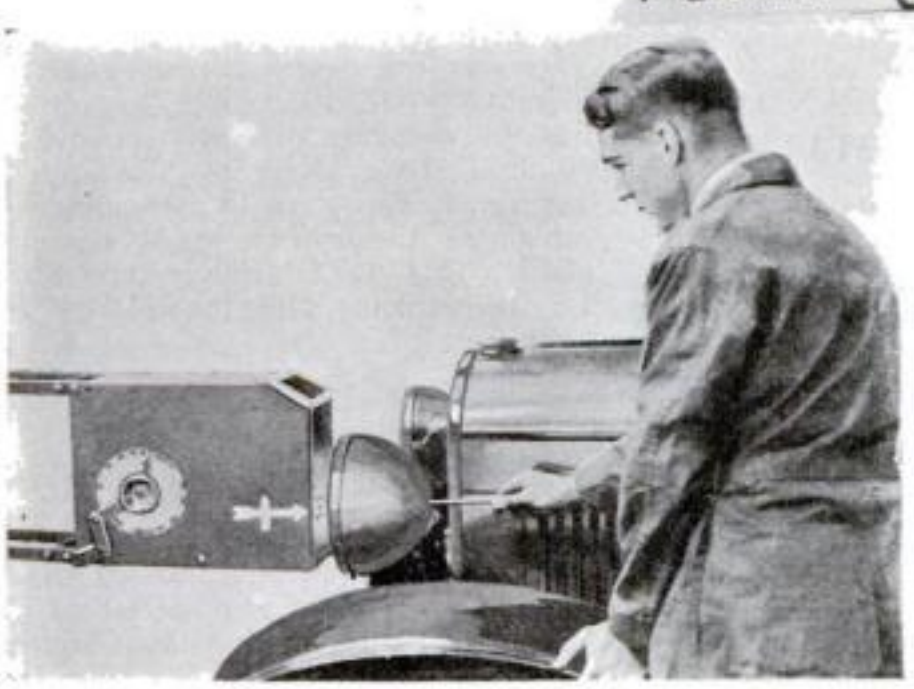
Air Mail Catapult

An improved portable catapult apparatus to enable a plane to pick up air mail "on the fly" is shown here during a recent test at Curtiss Field, N. Y. A cord stretched between two masts is caught by a hook lowered from the plane. An instant later a mail sack attached to the cord is shot forward at about the same speed as that of the plane.

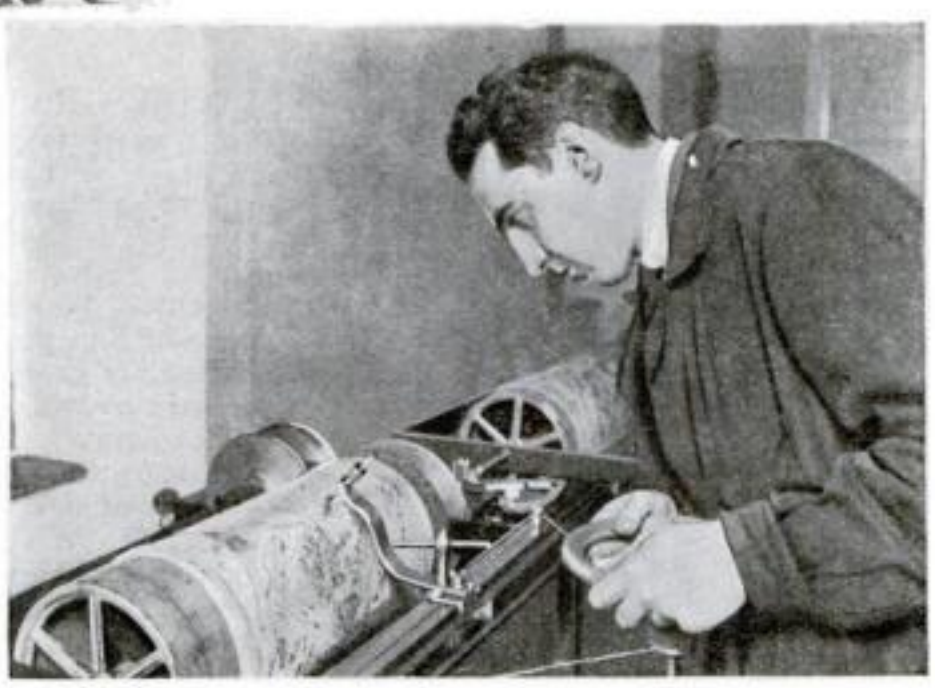


"Electric Eye" Detects Tunnel Fumes

A new instrument for testing the ventilation of the Holland vehicular tunnel under the Hudson River between New York and New Jersey includes a photo-electric cell which detects the slightest haze of exhaust vapors containing deadly carbon monoxide gas, as well as the presence of dust in the air. Above, at left, is an interior view of the instrument from the top. In the left center compartment is the photo-electric tube, and at the right is the light source with lens in front. In the rear section is the amplifying equipment.



New Headlight Tester. A pointer on the side of this test box is set to a number corresponding to the distance at which the lamp beam should strike the road. The lamp is then tilted until two bands of light, reflected on a screen at top of the box, coincide with two index marks.



Tests Auto Drivers. In this Austrian invention a roller bearing a small map of city streets is rotated beneath a stylus. Operating a miniature steering wheel which controls the stylus, the candidate for a driver's license shows his ability to thread his way through the streets.

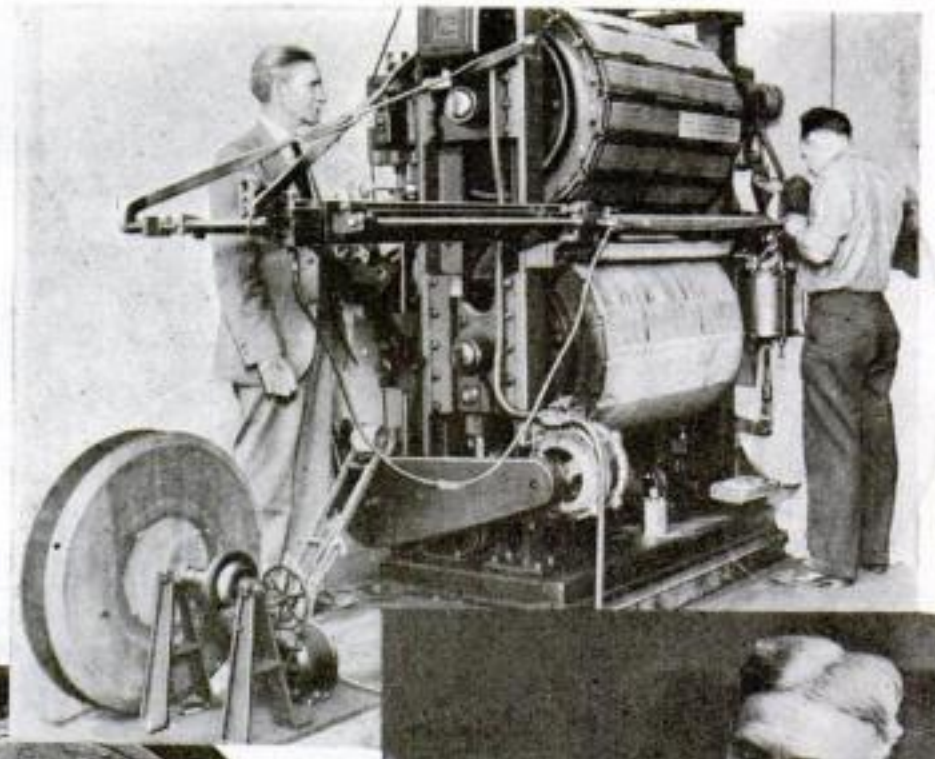
NEW IDEAS AND INVENTIONS

INVENTS COMBINATION GLOBE AND ATLAS

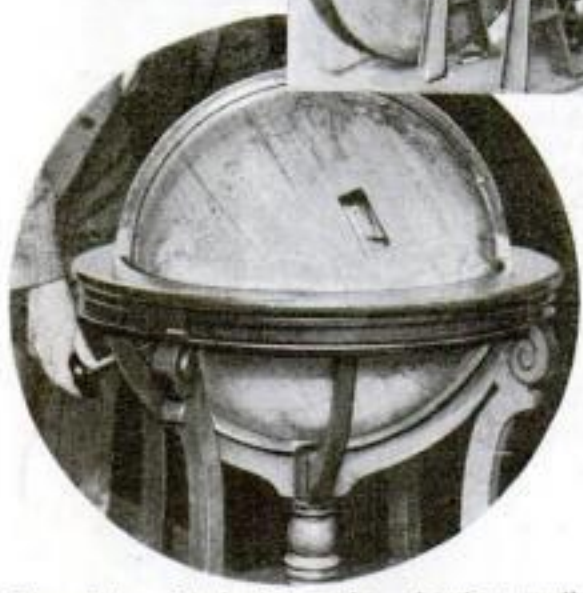
GLOBE and atlas are combined in the invention by a Los Angeles, Calif., map maker, of a model of the earth with a complete index and gazetteer inside it. Inserted in the globe are two small windows containing magnifying glasses. Inside is a mechanism that reels past this reading glass a fifty-one-foot paper tape bearing place names and descriptions arranged alphabetically.

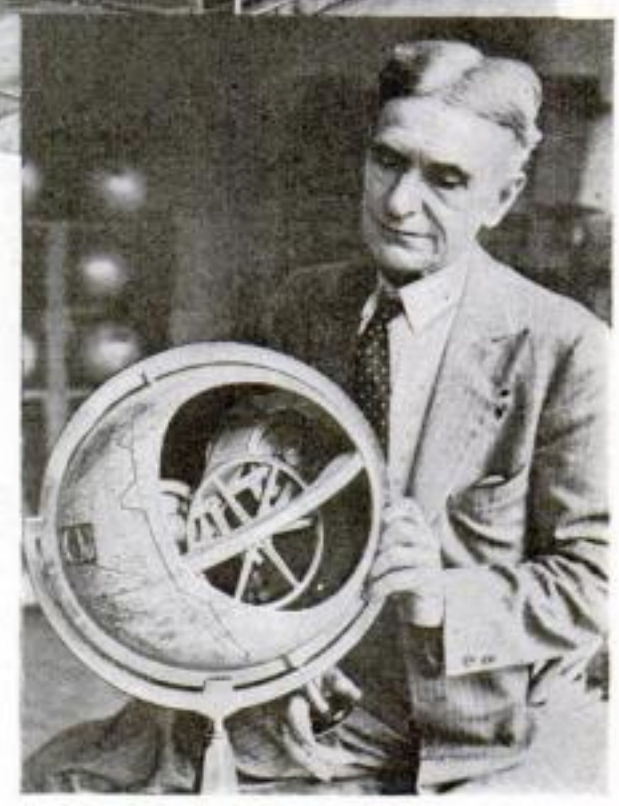
On this three-inch-wide strip are indexed 43,000 geographical names—more than ten times the number that it would be possible to print on a globe of this size. With each place is given its latitude and longitude, so that it may be located accurately upon the globe. A gazetteer on the same strip supplements the index with information about the population, area, industries, and other facts of all nations, states, and principal cities. By turning the handle any portion of this information, printed in microscopic type, is brought beneath one of the magnifying windows for easy reading. Twenty-eight lines of type to each inch of strip make it possible to crowd 200,000 words of information into the entire roll.

A special printing press was invented to print the roll in a continuous strip. It can print upon an unbroken spool of paper three inches wide and nearly two miles long when extended.



At right: The special printing press which turns out the paper tape index inclosed within the new globe-atlas. It can print a strip of paper nearly two miles in length.





The globe with built-in atlas, showing small window through which the index is read, and the handle for turning the index. At right: The globe cut away to show its interior mechanism.

MAIL BOX TELLS WEATHER

AN ORNAMENTAL letter box that will not only receive letters but tell the temperature and atmospheric conditions is the latest equipment added to the postal service in Paris, France. Standing on a base that resembles that of the "dummy policemen" in use in many American cities, the large rectangular box is decorated on each face with a border of ornamental tiles. A cabinet let into one side contains a barometer, and slots around the base of the pillar accommodate thermometers.

One of the new ornamental mail boxes. Thermometer and barometer are inserted in base.

NEW GRAVITY STANDARD FOR UNITED STATES

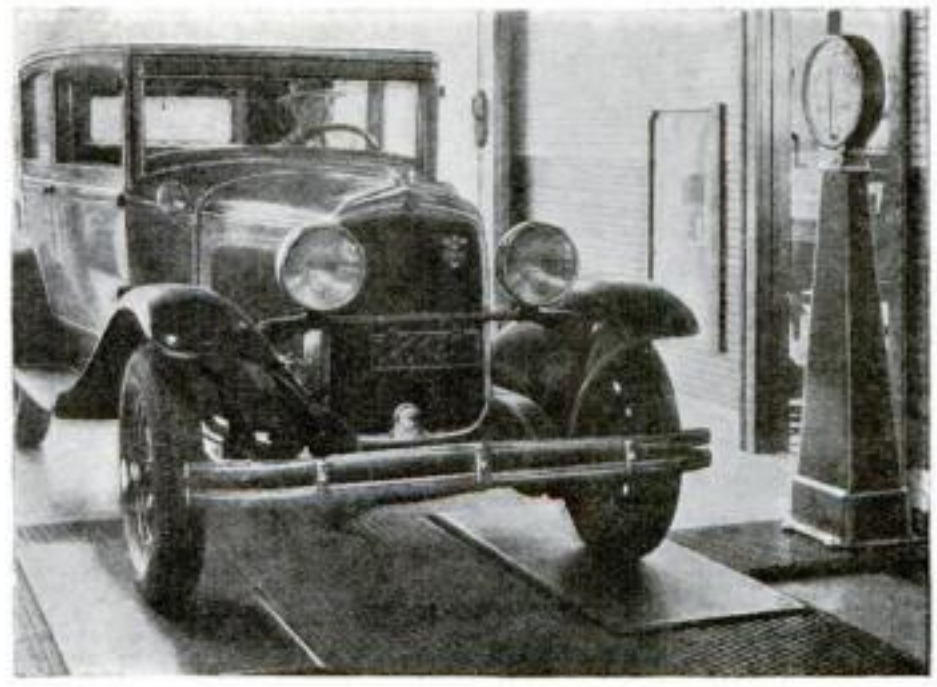
JUST how hard the earth pulls an object toward it is now being measured, by the United States Bureau of Standards, for the city of Washington, D. C. When the three or four year task is completed the United States will have for the first time a local standard of its own from which the force of gravity in any city of the United States, or the world for that matter, may be calculated. The exact value, known as small "g," is useful especially to physicists. There is a slight difference between "g" in one place and "g" in another, caused by differences in altitude and other factors, such as the density of the underlying rock.

Previously, according to Dr. Paul R. Heyl, Bureau of Standards physicist in charge of the measurement, the world's only reference standard for gravity was that of Potsdam, Germany, from which all local gravity measurements were computed. Recently some doubt has been cast on the degree of accuracy with which this was originally measured, and consequently a new world standard is to be obtained which will incidentally check the German one.

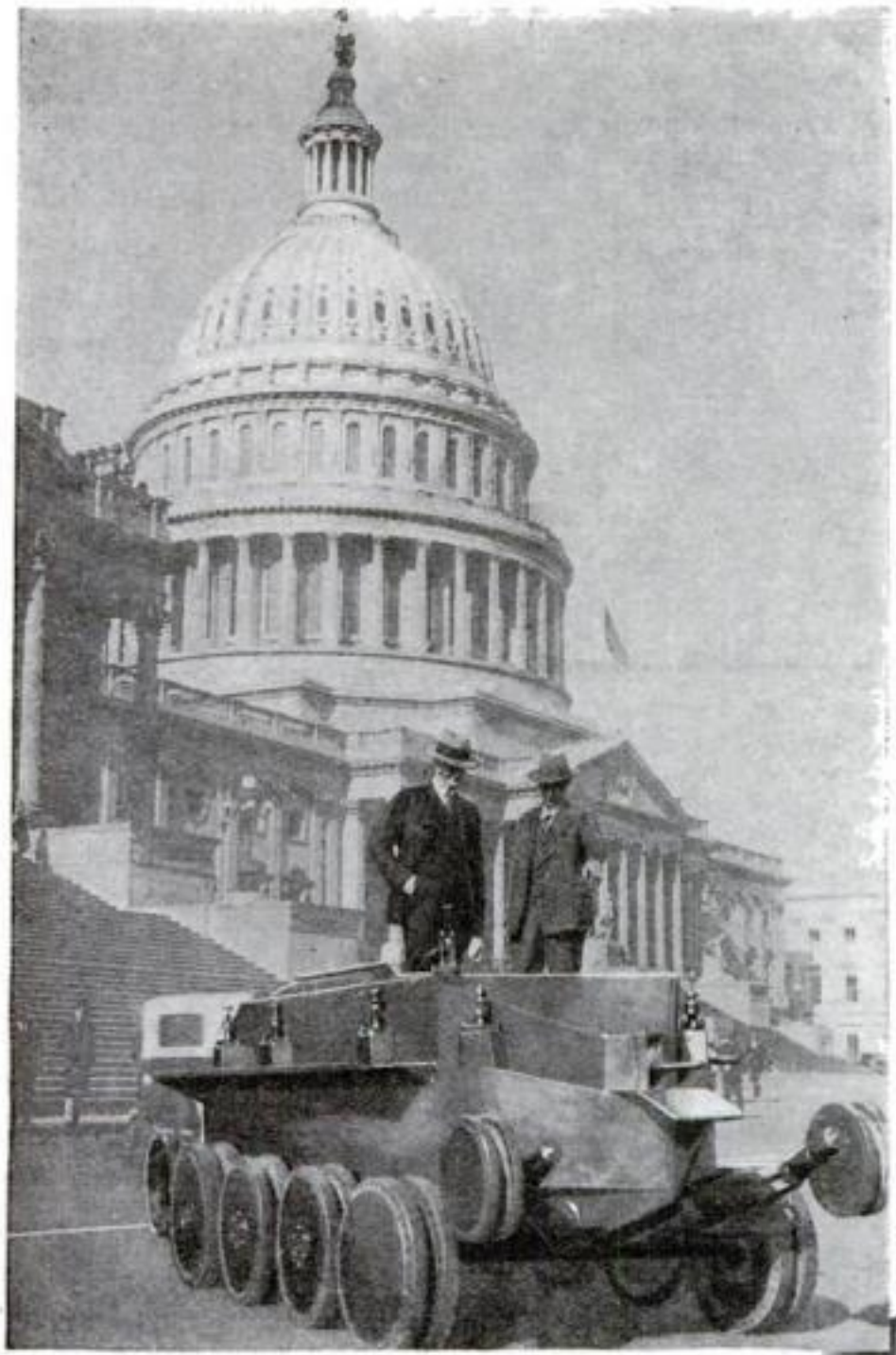
Dr. Heyl had previously completed the task of measuring what is known as Big "G"—the universal constant of gravity which, in one of Isaac Newton's basic formulas, determines the attraction of any body for any other of known mass. This was the experiment in which he literally "weighed the earth" by observing the swinging of heavy pendulums (P. S. M., June '28, p. 24). The figure he obtained is important to astronomers in explaining the movement of heavenly bodies. This "G" is a universal quantity, Dr. Heyl explains, while the small "g" is a local one.

TEST X-RAY SAFEGUARD

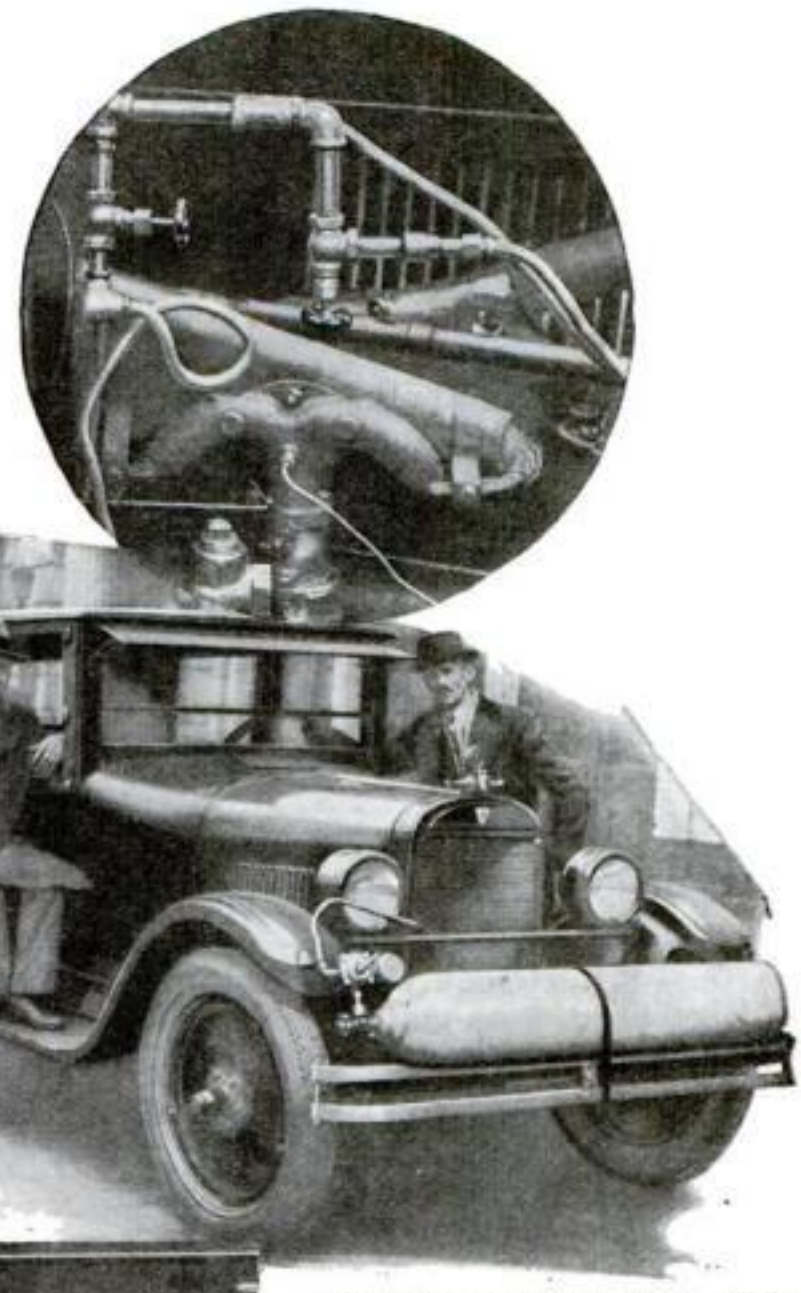
X-RAYS in sufficient dosage attack healthy skin as well as diseased tissue. The problem for cancer specialists has been to get at the tumor without injuring the healthy outer skin. Recently Drs. Edith H. Quimby and George T. Pack of New York City described experiments in which they used various combinations of rays—for instance, hard and soft X-rays or hard and soft radium rays together. A real increase in the capacity of the outer skin to resist the effects of the harmful rays was demonstrated, they reported.



Wheel Alignment Measured. When the front wheels of a car are run on to the two plates, shown above, a hand on the dial seen at the right indicates whether the wheels toe in or out. Wheels out of line move the plates, hooked up with the indicator hand. (See page 74.)

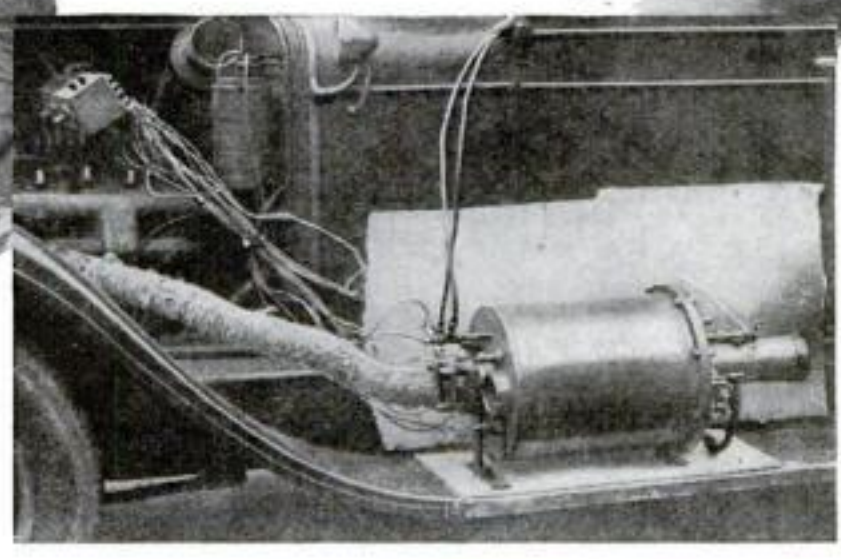


Speedy Tank for Smashing Attack. This combination tank and armored car will travel sixty miles an hour. Here, stripped of the endless treads, which can be taken off in a few minutes, it is being shown at the Capitol plaza, Washington, to Representative Henry E. Barbour, of the House Subcommittee on War Appropriations. It carries only three men.



Acetylene as Auto Fuel. Quick cold-weather starting, freedom from carbon monoxide, more power, and economy are features claimed by the inventors for a new system of fueling a motor car. Acetylene gas, mixed with air and water, is fed into the cylinders instead of gasoline by the carburetorlike apparatus seen in the circle above. The acetylene gas is carried in the tank on the bumper.

Chemist Fights Deadly Gas. Dr. J. C. W. Frazer, of Johns Hopkins University, shown above in his laboratory, has discovered a catalyst that will rapidly convert the deadly carbon monoxide into the harmless carbon dioxide. His process would rid city air of noxious fumes.



Testing the Carbon Monoxide Killer. At left is shown a car fitted with an experimental apparatus to test the efficiency of Dr. Frazer's method of changing carbon monoxide to dioxide.

NEW IDEAS AND INVENTIONS

The crystal ball sun-measuring machine at the Missouri Botanical Gardens. It makes an accurate record of the sunshine for each day.

ST. LOUIS BOTANISTS MEASURE SUNSHINE

HORTICULTURISTS at the Missouri Botanical Gardens of St. Louis can now tell exactly how many hours of sun their flowers are getting. A sun-measuring machine, said to be the only one of its kind in the country, records the daily sunshine there with the precision of a mathematical chart. The apparatus consists of a large crystal ball mounted on a concave brass holder, the crystal acting as a burning glass to focus the sun's rays on a sheet of specially prepared photographic paper lining the holder. As the sun crosses the sky, it leaves its mark on the paper as a line traced there by the rays transmitted through the crystal ball. The chemical coating of the paper is sensitive to sunlight.

NOCTOVISION TESTED FOR SHIPS LOST IN FOG

"NOCTOVISION," a form of television that uses invisible rays to see through darkness, was demonstrated in New York recently as a possible aid to American ocean liners steering through fog. If favorable reports are made by the commanders of three vessels, the *Leviathan*, *American Farmer*, and *American Shipper*, who witnessed the tests, the United States Lines may order one of the devices to be tried out at sea.

The shipmasters saw the device produce, on a screen, a clear pinkish image of a woman singer standing in total darkness in a room adjoining the laboratory. This device, invented by John L. Baird, British television inventor, employs invisible infra-red rays. On the bridge of a vessel, it is claimed, the apparatus would enable the skipper to pick up the infra-red rays from harbor or vessel lights even through the densest fog. It has already met with considerable success in British tests (P.S.M., Jan. '30, p. 46). In one experiment it is said to have picked up the headlight of a motor car three miles away, through darkness and fog, although the light was hooded with a screen so that only the invisible infra-red rays passed through.

CEMENT IS SHOT ACROSS RIVER IN AIR TUBE

ENGINEERS recently were confronted with the problem of how to get cement across the Allegheny River, in Warren County, Pa., for a sixteen-mile highway. They solved the puzzle by slinging a three-inch pipe, 768 feet long, from the freight cars on one side of the river to the mixing station on the other. A cable suspended it above the water. Compressed air at 100 pounds' pressure shot the entire supply of cement used in building the road through the pipe.

FINGER MOISTENER, IN PALM, HELPS CLERKS

SPEED and convenience are provided in a new finger moistener designed for those who handle loose papers. A small felt pad, mounted on a water reservoir about the size of a wrist watch, fits tightly into the palm of the hand, the combination itself being clasped to the hand by a spring grip which does not hinder finger movement. Thus the middle finger may reach down into the palm and be moistened while at the same time the hand as a whole is left free. Fumbling and the unsanitary habit of moistening in the mouth are eliminated.

Hidden in the palm of the hand, this device makes moistening of fingers quick and easy.

Besides being valuable for bookkeeping machine operators who wish to pick up ledger sheets quickly and easily and for those who file papers, the device is convenient for moistening envelopes.

NONPOISONOUS DYES NOW PAINT THE LILY

PAINTING the lilies is now an established fact, thanks to scientific research. Cut flowers have been colored artificially for some time past, but most common dyes are poisonous to the flowers and make them wilt almost immediately. Now, according to Dr. R. B. Harvey, of the Minnesota Agricultural Experiment Station, some brilliant, nonpoisonous dyes have been discovered.

Sweet peas, for example, are colored a brilliant blue five minutes after the newly cut stems are placed in a water solution of the dye. Lilies and carnations are also colored by the new dyes.

It is also found that flowers so dyed behave somewhat like photographic plates, and that miniature portraits, initials, or messages may be imprinted by light upon the dyed petals.

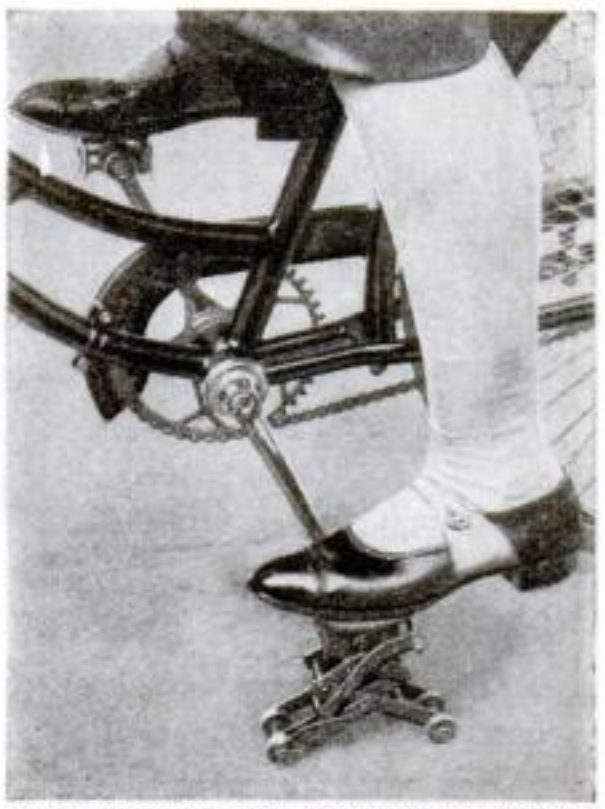
PROOF OF PARENTAGE IS FOUND IN BLOOD

FOUNDLINGS who are uncertain whether they have discovered their parents need no longer despair. A sure proof of parentage based upon the laws of colloid chemistry has been found, according to Professor Wilhelm Zangemeister, of Königsberg University, Germany, who would rely upon reactions between minute particles in the blood serum of the child and the supposed parent to confirm the relationship.

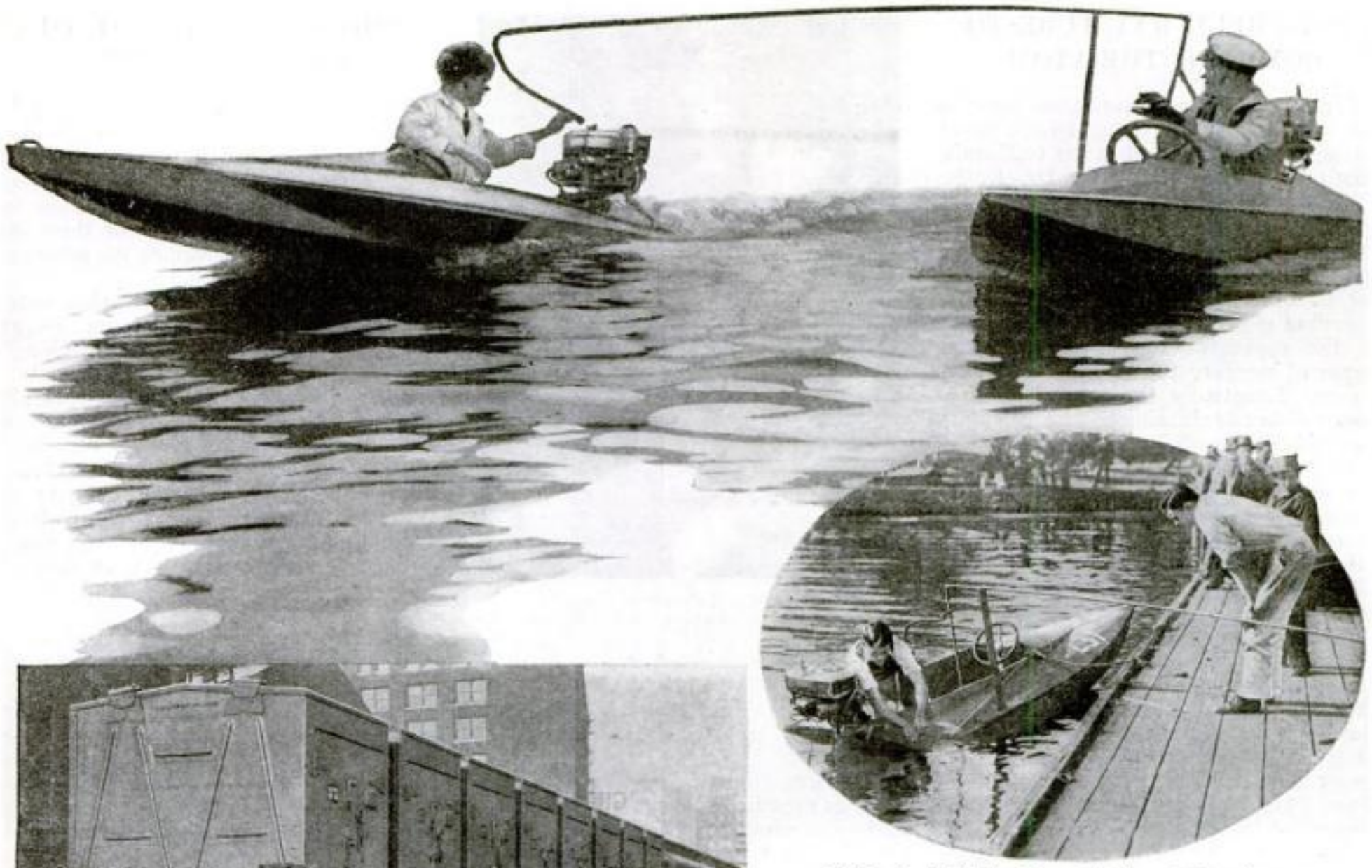
Blood serum is classed as a colloid, colloids being gelatinous or "gluey" substances. Professor Zangemeister believes some specific colloidal substance is handed on by the parent to the child, and that this substance may betray its presence in test tubes filled with the serums if a powerful light be shot through them.

NEW DEVICE SUPPORTS BIKE IN TRAFFIC

A CONVENIENCE for bicycle riders has recently been invented by a German experimenter. It is a device acting as a bicycle rest, especially handy when there is a traffic hold-up. Like a humpbacked roller skate in appearance, it fits beneath one of the pedals. Releasing a lever permits the roller frame to reach the ground and when the rider stops, he can park solidly in the roadway. But the contrivance also offers unlooked-for possibilities in another field of action. Should the rider, when wheeling merrily along at a fast pace, accidentally release the mechanism, it would suddenly hit the road and send the astonished cyclist sailing over the handlebars.

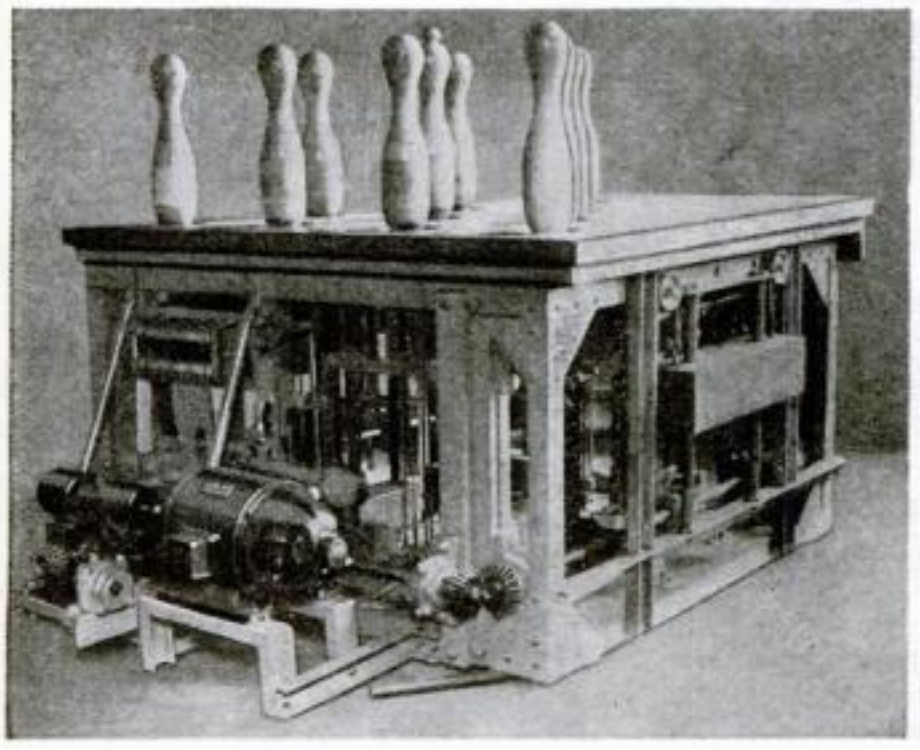


When pressed against the ground this German invention serves as a rest for the bicycle.



Refueling While Race Is On. Outboard motor racers, as shown above, can take on fuel without stopping. A fuel boat equipped with a pump, a hose, and a long pipe attached to its tank draws alongside the racing boat. The pipe is swung over the racer and fuel is pumped into its gasoline tank. In the oval is shown the first refueling motor boat, preparing for a test run at Oakland, Calif.

Section Freight Car Cuts Loading Time. This new railway car, recently shown in Chicago, is designed to do away with two of the steps in handling freight under the present system, as each section in the car unit can be trucked to the factory for loading or unloading.



Motor Takes Place of Pin Boy. On the North German Lloyd liners *Bremen* and *Europa*, electric motors have been installed in the bowling alleys to set the pins, each of which is controlled by a string. The machine also returns the ball to the player and indicates the score.

Fish Now Travel in De Luxe Car. The all-steel Pullman shown here was built for the United States Bureau of Fisheries and will carry 500,000 one-inch fish designed to stock the lakes and streams of America. E. C. Fearnow, the Bureau's superintendent of distribution, is seen holding a fish container. The car has kitchen, dining room, boiler room, berths for the crew, and special compartments for carrying the fish.

NEW IDEAS AND INVENTIONS

POWERFUL RAY TUBE TO BOMBARD THE ATOMS

NEW hope of smashing atoms open to see what is inside is brought by a novel vacuum tube developed at the California Institute of Technology by Dr. R. E. Vollrath. Although it uses only 250,000 volts of electricity—terrific pressure by ordinary standards, but little enough for atom-wrecking attempts—it is as powerful as other tubes of a million volts. Speeding electrons which it emits collide in the apparatus with highly charged vapor of mercury to augment their own power. Eventually the equivalent of a power of five or six million volts may thus be available.

It was long imagined that shattering atoms might loose titanic sources of power—might even wreck the earth in a great explosion. Recently Dr. R. A. Millikan, noted California Institute of Technology physicist, put such hopes and fears to rest. Atomic power is probably a myth, he said; the universe is "foolproof." Nevertheless, scientists would like to take atoms to pieces, among other things to see if they could transmute one element such as silver into another such as gold. The California experimenters, under Dr. Millikan, have already built several high-power tubes, possibly forerunners of one that will smash the atom. A 1,000,000-volt tube built last year produced rays that could be detected 300 feet away.

HALF OF WORLD'S RADIO SETS IN AMERICA

THERE are 21,629,107 radio receiving sets in the world, nearly half of them owned in the United States. This estimate shows that there is one receiving set for every twelve and a half persons in this country, as against one for every fifty-three persons in Europe.

These figures were quoted by the Electrical Equipment Division of the Department of Commerce at Washington. In addition to these facts the radio industry has few dependable data. For instance, the estimates of the number of sets sold during 1928 range all the way from 2,500,000 to 3,500,000, and the guesses for 1929 are even wilder. This gap in radio information will soon be filled.

Bracelet with bracket which clasps around the wrist and holds magazine or book for reading.

Dr. R. E. Vollrath, of Pasadena, Calif., with his vacuum tube that furnishes five million volts.

PAWPAW TREE FURNISHES FOOD, SOAP, MEDICINE

IN THE tropical mazes of South America grows a remarkable tree having a variety of uses both economic and medicinal. This is the papaya or pawpaw tree, to be distinguished from its cousin in the central and southern United States which belongs to a different family. The tree is an odd-looking affair, tapering from the base of the stem to a height of about twenty feet. It exudes a peculiar juice which, rubbed on meat, will make the toughest beefsteak as tender as venison. The natives living in the districts where the pawpaw tree abounds use the juice for this purpose.

In Paraguay the pawpaw leaves are used as a substitute for soap. The juice of the tree contains fibrin, a chemical protein elsewhere found only in the animal kingdom. However, the Field Museum of Natural History, in Chicago, which has one of these trees in its botany exhibit, states emphatically that the tree is not to be regarded as a link between the animal and vegetable worlds.

The juice is an acrid, milky substance and has medicinal value. The seeds are used as an effective vermifuge or worm destroyer. Furthermore, the tree has a delicious fruit. It is large, pulpy, oblong in shape, and has a heavy rind.

HANDY BRACELET SERVES AS MAGAZINE HOLDER

WHAT might be a convenience to readers is a unique wrist attachment recently designed for holding magazines and small periodicals open before the eye at arm's length. This novel book holder is a bracelet fitting snugly about the forepart of the wrist, to which is fixed a small bracket firmly supporting the periodical just as the "lyre" of a cornet supports sheet music.

The device is adjustable to any wrist, and may be obtained in sterling silver or nickel, silver, or gold plated.

SHOOT POISON DUST TO KILL MOSQUITOES

Two battles in which no quarter is asked or given are man's fights with insects and disease. These are combined when communities fight mosquitoes, for these insects are not only annoying in themselves, but some kinds of them do enormous harm by spreading the germs of malaria.

Poison gases and other chemicals, widely condemned in human warfare as too barbarous for use, meet with full approval. Several years ago mosquito-fighting experts used airplanes to sprinkle a poisonous dust over infested areas. For the coming summer the malaria experts of the United States Public Health Service will use blowers, mounted on boats or automobile trucks, to scatter the dust. The dust used is Paris green, a chemical compound of arsenic and copper, diluted with about eighty-five percent of slaked lime.

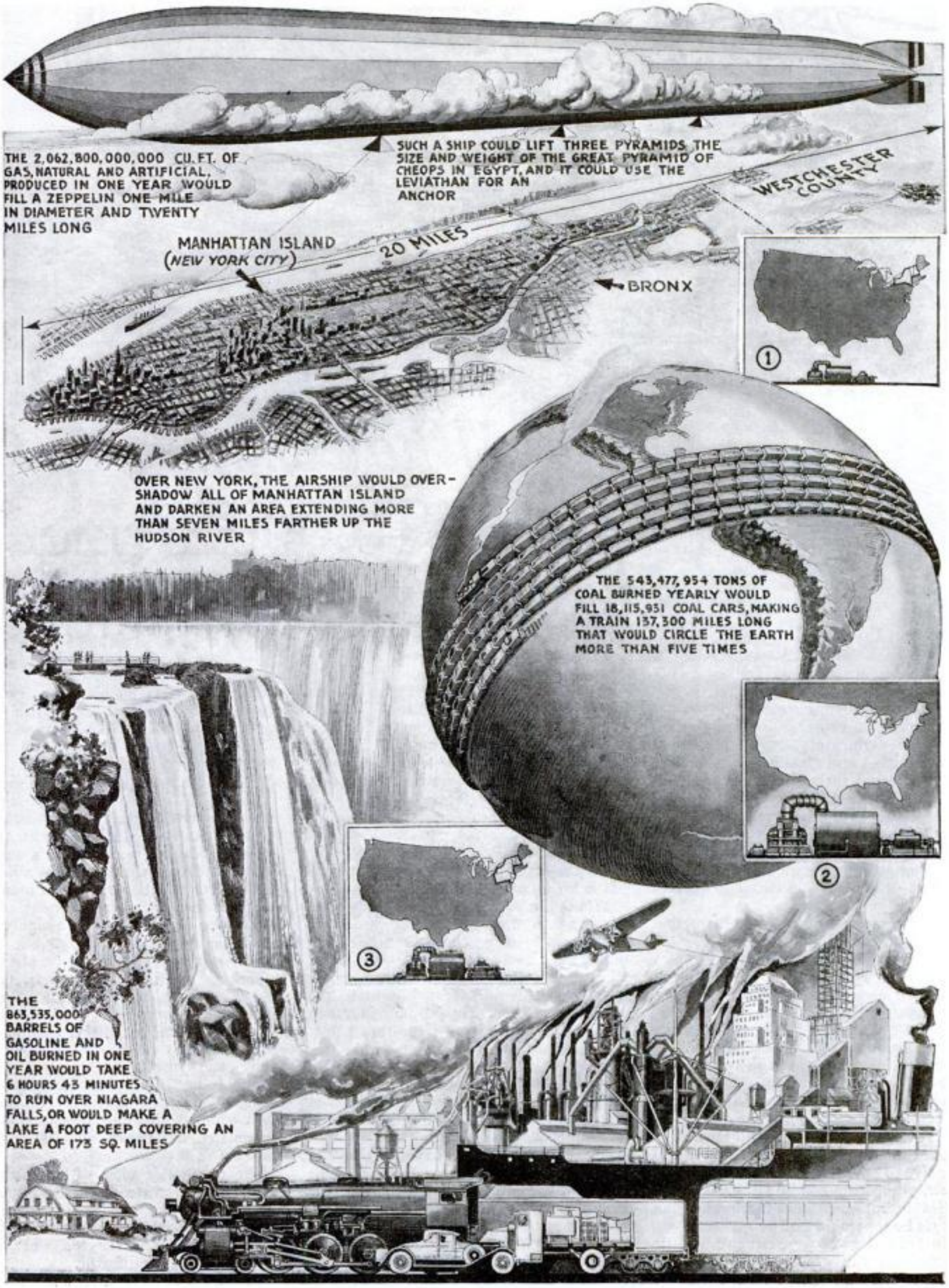
That this is effective against the insects is due to the habits of the mosquito's child. Out of mosquito eggs hatch tiny larvae, many of which can be seen on the surface of an infested ditch or pool. These are the "wigglers." They seek the surface of the water to breathe, for these larvae are air-breathing, although they live in water. The poison dust scattered by the new machines floats on the water surface. Wrigglers coming up to breathe get some of the dust into their bodies Numerous and unlamented deaths result.

NOVEL LIP FORM JUST STAMPS ROUGE ON

RAQUEL TORRES, the famous film star, is responsible for a new device for lip rouging. A wooden stamp, shaped to the form of the lips and covered with rouge, is pressed against the lips, thus stamping the rouge on. The stamp comes in various sizes, to fit the lips of small as well as large featured persons.

Raquel Torres demonstrates the use of her lip-shaped wooden stamp for applying rouge.

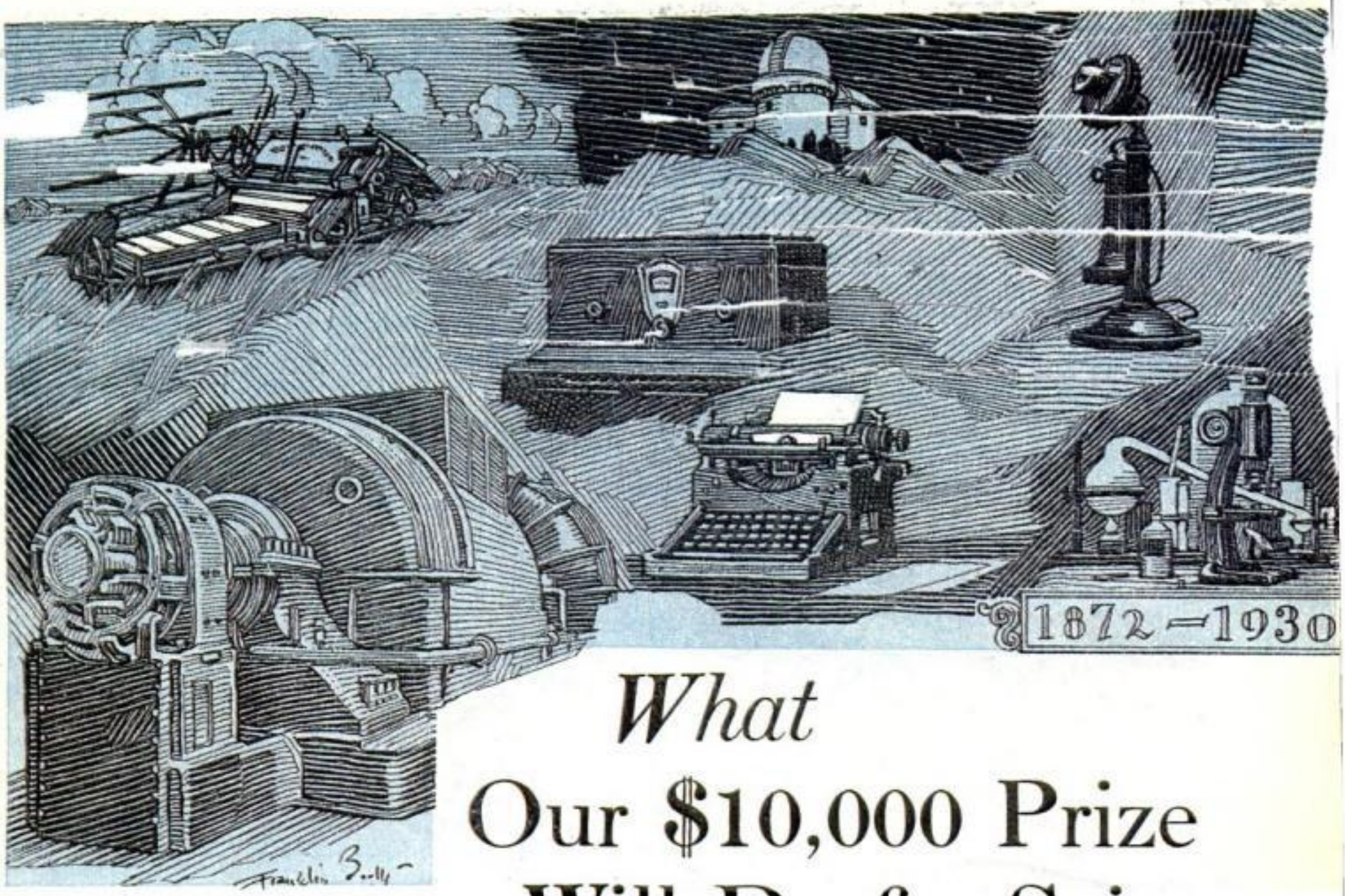
What We Burn Up Every Year



(1). The total energy in gas burned in the United States in a year would run a 530,000-horsepower turbo-generator and supply electric light to New York, Vermont, and New Hampshire for 176 years.

(2). A 3,300,000-horsepower turbo-generator could be driven by the energy in the coal burned in this country in one year, and this could supply light to the entire United States continuously for 176 years.

(3). The energy in gasoline and oil burned in America in a year would run a 1,000,000-horsepower turbo-generator and supply light to New York and four neighboring states for 176 years.



What Our $10,000 Prize Will Do for Science

WHAT do representative Americans think of POPULAR SCIENCE MONTHLY'S annual award of $10,000 for the year's outstanding achievement in science?

Scientists, inventors, and engineers; statesmen, educators, and clergymen; industrialists and business executives have expressed their opinions since publication, in the February issue, of the announcement of the creation of the award and the formation of a committee of distinguished scientists who will select the accomplishment which, in their judgment, is of greatest potential benefit to the world.

The comments of these men are especially significant because they present a lively discussion by some of the best minds in the country of the value of prize awards in general and their merit as a stimulus to scientific endeavor in particular. A vast majority of those giving their reactions were enthusiastic. They agreed unreservedly that the award—the largest single monetary prize of its kind in America—by recognizing and focusing public attention upon the unselfish labors of scientific workers and rewarding superior attainment, will serve as a real incentive to scientific and inventive effort. A few, while commending the magazine for its intentions, voiced apprehension that its hopes would not be realized.

Most of those who were not enthusiastic objected on the ground that scientific endeavor has not been and will not be stimulated by monetary reward or hope of gain.

This, like most generalizations, is only partly true. POPULAR SCIENCE MONTHLY has never held that by giving each year $10,000 to some worker in science it could make scientists work harder, achieve more, or even bring more recruits to their ranks. No one who is willing to devote his life to science for the betterment of his fellow men or for the satisfaction of his own inclinations needs the spur of such a reward.

Nor would $10,000 urge on to greater effort the man who sees millions for himself if his invention succeeds.

What the award can do, and what POPULAR SCIENCE MONTHLY insists it will do, is to focus the attention of the public on those who, for any reason at all, are laboring to accomplish results that eventually will be of benefit to the public—of greater benefit than they can ever be to those who accomplished them.

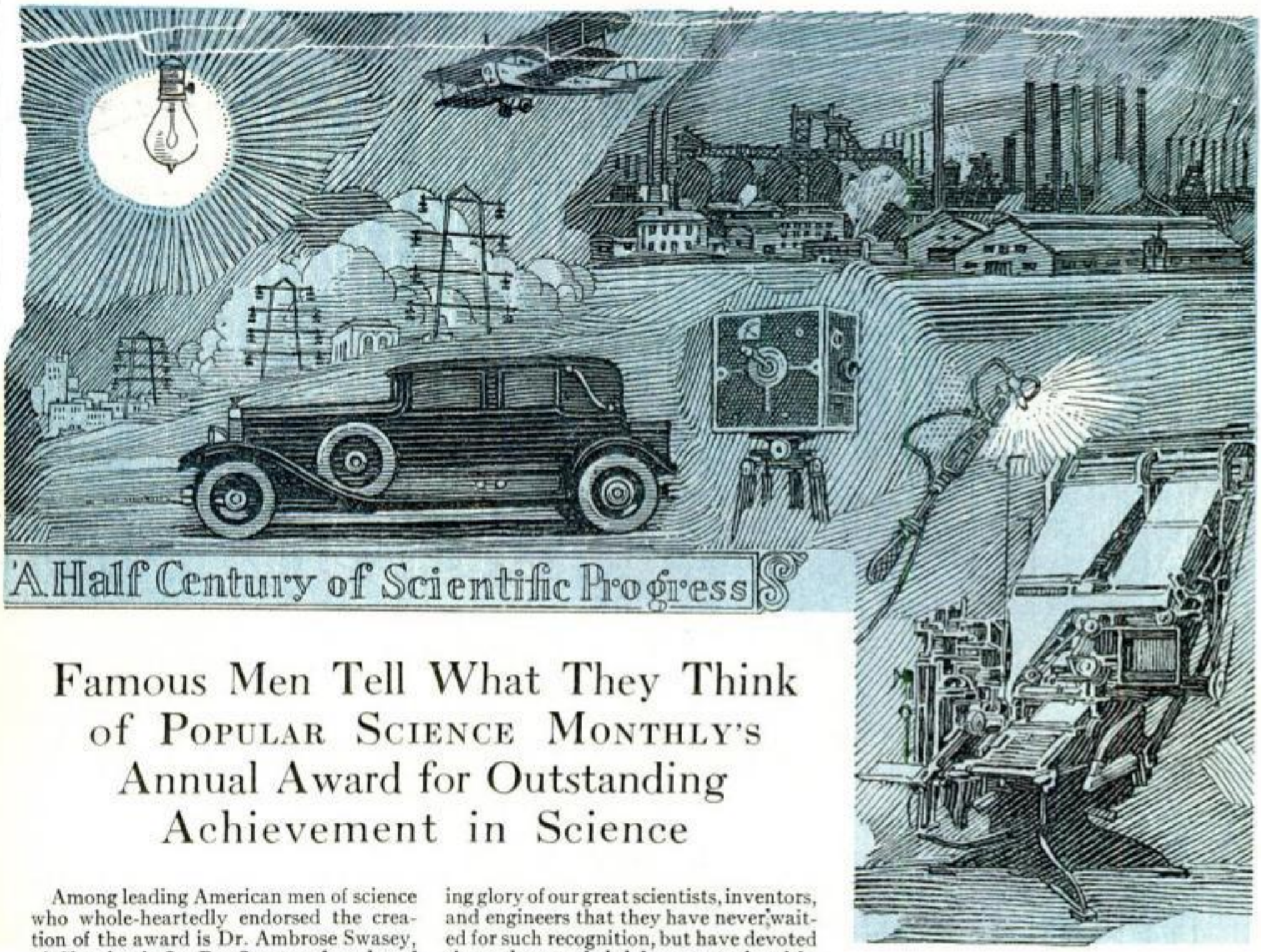
More and more, as industrial civilization progresses, the daily lives of men are ruled by, and even founded on, science. There is almost nothing that civilized man does, nothing that he uses, that is not somehow dependent on the works of science. It is to impress this fact on the public, even more than to reward or stimulate scientific endeavor, that the POPULAR SCIENCE MONTHLY Annual Award has been instituted. If, therefore, the award does nothing more than emphasize this fact, it will have justified its creation.

No one is in a position to speak with more authority on this subject than America's distinguished scientist and inventor, Thomas A. Edison. To the project he has given his unqualified approval and expressed his entire confidence in the benefits to science and mankind that are bound to result from it.

"IT HAS been a source of much pleasure to me," Mr. Edison wrote, "to read the announcement of the recent creation by POPULAR SCIENCE MONTHLY of an annual award of $10,000 for the year's achievement in science that shall be adjudged of greatest potential benefit to mankind. To my mind the establishment of this very liberal annual award is a highly commendable example of the public spirit displayed by POPULAR SCIENCE MONTHLY in seeking to stimulate the activity and aid of investigators in the realms of science and research. I have no doubt that the working out of this plan, in practice, will result in great benefit to mankind. Allow me to congratulate you on the great incentive you have offered to scientific workers, and also to compliment you on the fine personnel of the Committee of Award which you have chosen."

The majority's view of the award is strikingly epitomized by Secretary of the Interior Ray Lyman Wilbur, formerly president of Stanford University, California, and noted for his work as a physiologist and educator.

"We need to have science and its work appreciated," he wrote, "since the future of our country depends upon the proper relationship between science and democracy."



Decoration by Franklin Booth

Famous Men Tell What They Think of POPULAR SCIENCE MONTHLY'S Annual Award for Outstanding Achievement in Science

Among leading American men of science who whole-heartedly endorsed the creation of the award is Dr. Ambrose Swasey, of Cleveland, O. Dr. Swasey, founder of the Engineering Foundation, is the builder of most of the great telescopes in this country. He is the inventor of the Swasey range and position finder adopted by the United States Government.

"It gives me much pleasure to express my appreciation of the institution of your splendid award," wrote Dr. Swasey, "and I am confident it will prove to be a wonderful incentive in the realm of scientific research.

"No doubt the consciousness of notable achievement is the greatest award that can come to one; yet the recognition of such achievement by those eminently qualified to pass judgment in that particular field of scientific research, must be especially gratifying and inspiring.

"It is indeed most fortunate to have lived in the marvelous age of discovery and development in science, from the time of Bell to Marconi, from Pasteur to Curie, and from Langley to Lindbergh; and I firmly believe that in the coming half century even greater storehouses of knowledge will be unlocked by the scientists for the good of mankind."

Typical of a great number of congratulatory messages was the comment of another member of President Hoover's cabinet, Secretary of Labor James J. Davis, who said:

"I heartily endorse your movement to reward with a medal of honor and with a handsome purse each year the scientist or inventor whose work has accomplished most for humanity. It is to the everlasting glory of our great scientists, inventors, and engineers that they have never waited for such recognition, but have devoted themselves to their labors not only without fit remuneration but often at serious cost to their physical and material well-being. On that very account it is high time that their achievements for humanity should be singled out for suitable honors, accompanied by substantial financial aid. Humanity needs to become better acquainted with those who add to its knowledge, safety, and comfort. Your plan for an annual award is a timely step in that direction."

Among the opinions of leading scientists who are in complete accord with the spirit in which the award was created, that of Dr. Michael I. Pupin, inventor and professor of electromechanics in Columbia University, New York, is representative.

"The creation of the award," wrote Professor Pupin, "is a splendid move in the direction of enabling gifted but impecunious scientists to provide themselves with means for continuing their splendid efforts."

Dr. C. E. Kenneth Mees, director of the research laboratory of the Eastman Kodak Company, Rochester, N. Y., was one of the small group of distinguished men who expressed doubt of the award's efficacy as an incentive to scientific effort.

"I cannot imagine any scientific man to be stimulated to do better scientific work by the possibility that his work might receive a cash award at the end of the year," Dr. Mees wrote. "Nor do I think it is possible to tell at the end of the year what work done in the year ending three months before will be of greatest potential value to the world."

A view almost exactly opposite to that of Dr. Mees was given by Glenn Curtiss, aviation pioneer, who said:

"Allow me to compliment you. I think this is the best possible way to stimulate invention.

"In the early days of aviation it was the cash prizes offered by the *World*, *Herald*, and *Times* that made possible the experimental and research work which led to the development of the hydroaeroplane and the flying boat."

Agreeing with this opinion, J. F. Callbreath, secretary of the American Mining Congress, said:

"I can conceive of nothing more helpful than such a plan as you have put in operation to stimulate scientific research."

Like Dr. Mees, Dr. Gustav Lindenthal, famous bridge building engineer, objects to the designation of a year as the period during which a piece of scientific work worthy of distinction may be both achieved and brought to light.

"I do not favor the notion," wrote Dr. Lindenthal, "that there must be an award annually to someone for conspicuous progress in some field of science. Conspicuous progress in any field of science depends upon exceptional mental qualities of some individuals. They do not appear annually or in other regular periods." (Continued on page 137)

Here are the man, the camera, and the plane just back from an air map making trip in the clouds.

How Air Camera Men Map Unseen Places

By CHARLES F. KEALE, JR.

A BOXING match was scheduled for the evening in a Coney Island, N. Y., stadium. It was already noon, and soon tickets were to be placed on sale. The promoter of the match looked for the floor plan to show purchasers their seats. He found to his consternation that there was no floor plan.

Fortunately it was a beautiful, cloudless day. Luckily, a friend of mine happened to hear of the promoter's plight and had our office on the phone at once.

Early in the afternoon, an airplane soared over the grandstand, dipped low, and scudded away. An hour or two later an aerial photograph lay on the promoter's desk. It showed in clear detail every row and seat. Hurriedly labeled with pen and ink, it became the floor plan for that evening and for many that followed.

That was the simplest air-mapping job we ever did, since it needed only a single photograph. But in the six years that I have been in the air-mapping business, we have made maps that required thousands of separate pictures. By a specialized process they were dovetailed together with a degree of accuracy of better than one percent. Such accuracy means that enlargements must match within a hundredth of an inch.

Why map from the air? First, because there are certain purposes for which only air maps can be used. Second, because for all kinds of mapping it is fast and inexpensive. Third, because an aerial map of a city, for example, shows buildings, streets, and houses with a clearness that no other type of map can approach.

EVEN a person who has lived in a city a long time can learn something about it from an air map. A young man told me the other day of discovering that each Sunday morning for months he had walked two blocks out of his way through the crooked streets of Greenwich Village, a district of New York City, in order to reach his favorite breakfast place. An aerial map of New York showed him that by starting in another direction that seemed wrong he would actually get there sooner.

The firm which I head, the Airmap Corporation of America, makes two kinds of air maps—"oblique," with photographs taken slantwise from the plane, giving a "bird's-eye view" in perspective—and "vertical," with the camera pointing straight down. Unusual requirements sometimes make the first kind preferable.

ONE time at a banquet of public utility officials in Brooklyn, N. Y., I brought up the idea of air-mapping the borough. An official of the local electric company was interested; he wanted to know whether we could make a series of photographs that would show among other things the type of building in each section. The company was considering a change in the kind of electricity it supplied its customers, and knowing whether a certain section contained frame houses or industrial buildings would aid in forecasting the type of service required.

I made a few sample photographs taken vertically, but they did not show the style of building plainly enough for the company. So we contracted to make, instead, a complete survey of Brooklyn using oblique photographs. We took the door off a cabin plane, because the window was too high for good photography, and started shooting.

To make oblique pictures, the pilot would tilt the speeding plane on its side while Eric F. Dixon, head of our photographic department, crouched on his toes and fired away through the open door. That was how we almost lost one of the best aerial camera men in the country. Everything was going fine when the plane hit a bump in the air and Dixon started out the open door. I guess he thought he was never going to see his two pairs of twins back home in Hanover Neck, N. J., again. A quarter inch of his elbow, he says, was all that saved him from going out. After that we built a special door for the plane, with a safety window in it, to finish the picture-taking job. When we were through we had a book of maps that showed how many stories every house in Brooklyn had.

The vertical maps are the ones mostly used, and we get some queer orders. For instance, a railroad in New Jersey, serving an iron mine, was charged by the Interstate Commerce Commission with maintaining excessively high rates. The Commission based its claim on the alleged fact that the railroad was serving a populated suburban area. We were engaged by the railroad to make an air map of the route. No better evidence could be needed of the bleak, desolate, uninhabited region through which the

This photograph of a Coney Island, New York, stadium, taken from the air, was enlarged and used as a seating plan in an emergency.

tracks of the railroad passed.

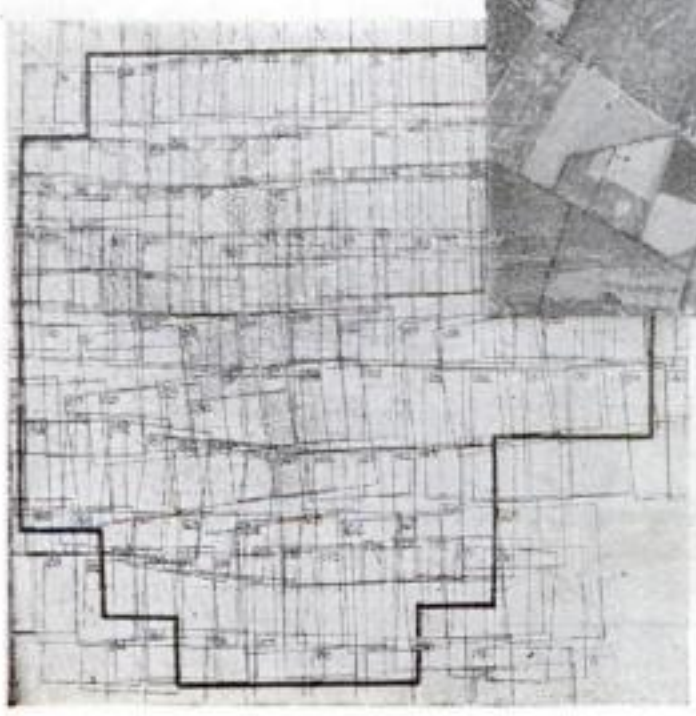
Recently we completed an entirely different kind of map for the Government—a survey of the Mississippi River delta where the river enters the Gulf of Mexico. The pictures, showing the course of the river water through the tortuous channels, will be used to aid in flood control work. To photograph the course of the muddy Mississippi water far out into the Gulf, we flew land planes as far as five miles offshore—thirty-five miles from a safe landing place. A forced landing would have meant all kinds of trouble, but none was necessary. In our six years of flying we have had no accidents, and only one forced landing, made without difficulty, when a motor quit right after the take-off.

All photos courtesy of Airmap Corporation of America.

Here is how the Mississippi River looks to an aviator high in the air above it. The picture was taken as one of a series made to aid the Government in its efforts to control the floods in the neighborhood of New Orleans, La.

ONE reason we don't have trouble is that we are "fair weather flyers." We don't go up unless the day is fine for pictures, and that means fine for flying, too. Even in summer we can count on only one good picture-taking day out of five. In winter it's only one out of fourteen. Sometimes the perils of air mapping are worse on the ground than in the air. The story is told of a pilot and a photographer sent up to the Adirondack Mountains, in New York State, to map a route for an electric transmission line. They had the job all but finished when a spell of bad weather set in. For about three weeks they sat around doing nothing whatever. One night the pilot went to a show. Directly after the show he married one of the actresses. Next day dawned clear and fine—and no pilot. Before he appeared at the landing field, the bad weather had shut in again and continued for three weeks more.

Sometimes if the weather is not too thick we can take pictures in spite of it. When we air-mapped Allentown, Pa., to aid the civic authorities in planning the outward growth of the city, we struck heavy haze. By using a special screen on the camera lens, that cut through the haze, we were able to get good photographs of the ground when it was actually invisible to the naked eye from the plane. The screen is a piece of colored gelatin that allows only the long light waves that penetrate fog to pass through it to the film in the camera. Even in good photographic weather, a yellow screen is often used in front of the camera lens to clear up the atmospheric haze, its action being a little weaker than that of the special screen.



These three pictures show various steps in the process of making air maps. The strip above shows how the photos overlap so that only the directly vertical part of each exposure is used. Directly above is an air view of Allentown, Pa., made with a special screen when the town was hidden in haze. At left is the index map used in order to get the hundreds of air pictures correctly placed. Here the overlapping of separate photos, which are numbered, can be seen.

One thing that air mapping has done is to revolutionize the methods of "timber cruising." When a paper company negotiates for a tract of land containing standing timber, it wants to know how much wood it can get out of the land. The old way used to be to send a man known as a "timber cruiser" through the tract. He would stand on top of a hill and try to guess how many trees there were in the surrounding territory. Sometimes his guess would be right, but more often wrong. Nowadays an aerial photographer flies over the land and takes pictures from which an exact estimate can be made. In winter they even show whether the wood is hard or soft; the softwood evergreens stand out against the snow.

MAKING an air map is a highly developed art. A good example of the way that it is done is the tax map which we made of Nassau County, Long Island, N. Y.—one of the biggest jobs ever done, requiring 3,000 separate photographs.

An airplane map often reveals houses and lots that never have been discovered by the local tax collector, and that will bring a city thousands of dollars of added revenue. But in Nassau County the need of an up-to-date map was even more acute. The country had suddenly blossomed out with real estate developments. There was no tax map in existence. The new administration was confronted with the prospects of (*Continued on page 155*)

Louis Daguerre gave up wealth and fame to follow, for fifteen years, the fantastic dream of "painting pictures by sunlight."

First Photo Took 8 Hours

Now–20,000 in a Second

By H. C. DAVIS

IN 1830, it required eight hours to take a photograph. The other day, Baron C. Shiba's remarkable camera recorded 20,000 pictures in *one second* (P.S.M., Nov. '29, p. 31). In this dramatic advance, which has taken place within a single century, a Parisian painter of stage scenery and a magic cupboard in his home workshop laboratory played leading rôles.

The painter was Louis Daguerre, who made photography practicable. Before his time, a few indifferent pictures had been made by the painfully slow process of exposing asphalt-covered plates all day and then treating them with solvents. One day Daguerre exposed an iodized silver plate. From shortness of exposure or dullness of light, it showed no trace of an image. Intending to recoat the plate and try it again next day, Daguerre placed it in an old cupboard. The next morning he was amazed to find on it a distinct image. He put another underexposed plate in the magic chest. At the end of twenty-four hours, an image had appeared on that plate also. Then the experimenter went to work to find which of the chemicals stored in the cupboard was responsible for this unexpected development of the plate. In the end, he found mercury was doing the work. This accidental discovery of the effect of mercury upon the exposed plates cut the necessary time of exposure from hours to minutes. After a dozen years of ceaseless labor, a lucky moment aided Daguerre's success.

DAGUERRE'S life, in its ups and downs, its dramatic turns of fate, reads like a romance. He was born in 1789, the year of the Revolution, in the little village of Cormeilles, near the mouth of the Seine. As a child he was neglected by his parents and ran ragged through the public square. Now in that square there stands a monument, raised by grateful artists from all parts of the world, in memory of his remarkable achievements.

For a time, Daguerre worked as an inland revenue officer. Then, without friends or money, he set out for Paris to make his fortune. By native ability, he became the leading scene painter for the French stage. His original mechanical effects were the talk of Paris. His "diorama," a gigantic painting exhibited first in reflected and then in transmitted light, gave the weird impression of the same scene perceived first in sunlight and then in moonlight. The French Academy of Fine Arts made him a member. His days of struggle apparently were over. He had become rich and famous. At this point he began to neglect his work, to spend his days and nights laboring in a little home workshop, to fuss with ill-smelling chemicals and queer looking apparatus. He began to slip back into poverty and hardship in order to follow a dream—a fantastic dream of painting with sunlight.

Daguerre's cabinet of chemicals ended a twelve years' search and revealed to him, by chance, a secret which led to modern photography.

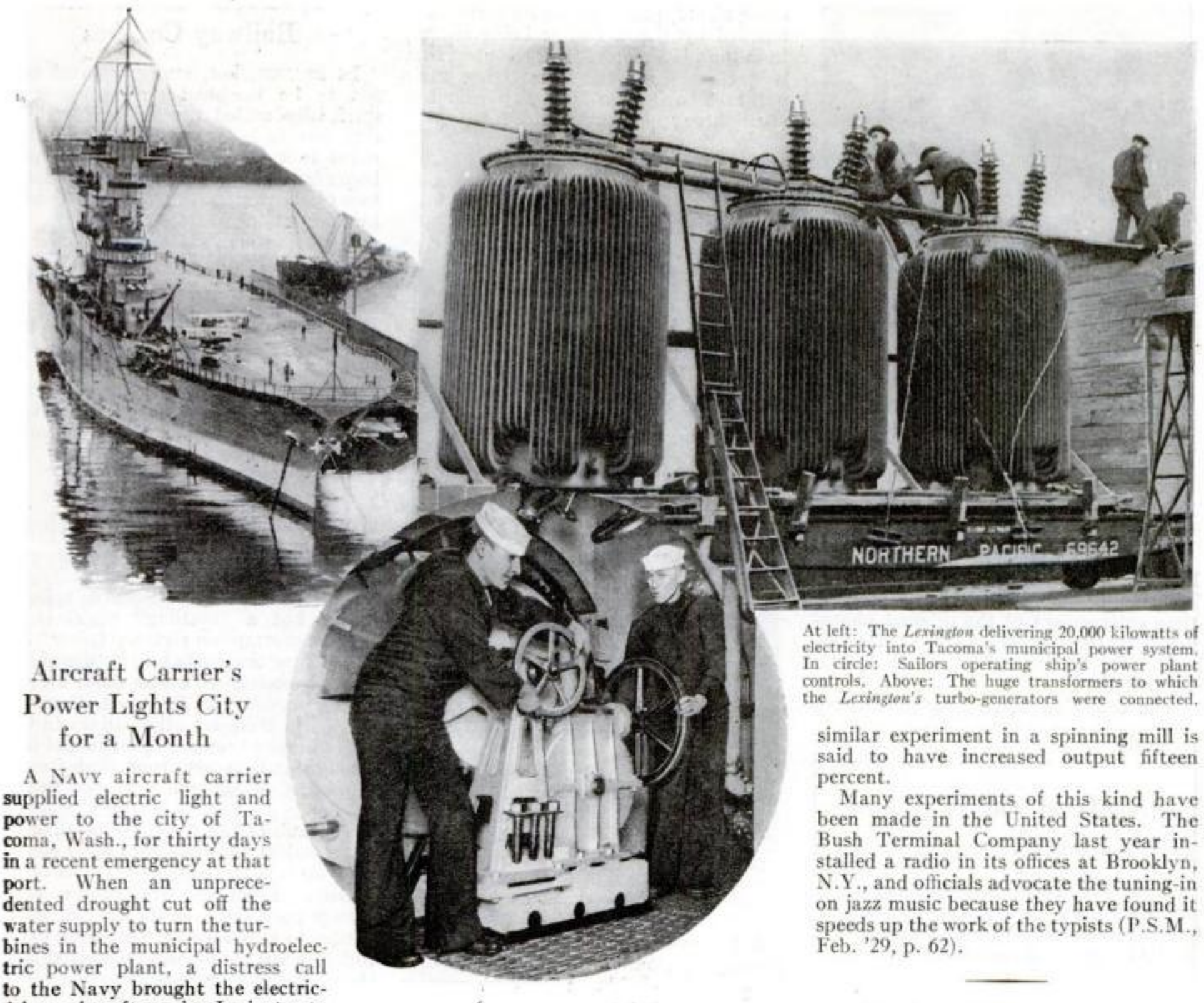
FOR years, in his scene painting, he had employed a camera obscura to sketch from nature. This dark box, having a lens-covered aperture through which light from external objects entered and formed their image on the side of the box opposite the opening, had been familiar to artists since the time of Leonardo da Vinci. About the middle of the sixteenth century the Italian philosopher, Porta, had invented it. Crowds had flocked to his home in Naples to see the wonder. Wealthy Italians of the time built little dark rooms on hilltops to form private camera obscuras where, with friends, they viewed images of the countryside on the darkened walls. In its mechanism, the human eye is a small camera obscura, and all modern cameras are adaptations of Porta's discovery. For three centuries, artists, using this apparatus, longed to make permanent the fleeting images painted within by sunlight. This Daguerre set out to do.

Friends told him it was impossible. Reputable scientists called the plan as futile as an attempt to capture a mirage. Sir Humphry Davy, English chemist, had tried and failed. Yet, without previous scientific training, the scene painter struggled on, undaunted. When his fortune disappeared and he continued to work at the seemingly hopeless task, his wife consulted a physician, fearing her husband was losing his mind.

That was in 1825. For fourteen years more, Daguerre worked ceaselessly, until, in 1839, he was able to announce his great discovery. Other experimenters, Sir Humphry Davy, Thomas Wedgwood, Joseph Niepce, paved the way for him, perhaps. But it is to this (*Continued on page 145*)

PROGRESS AND DISCOVERY

Important achievements in engineering, exploration, and discovery, and the latest news of the world's progress in science



At left: The *Lexington* delivering 20,000 kilowatts of electricity into Tacoma's municipal power system. In circle: Sailors operating ship's power plant controls. Above: The huge transformers to which the *Lexington's* turbo-generators were connected.

Aircraft Carrier's Power Lights City for a Month

A NAVY aircraft carrier supplied electric light and power to the city of Tacoma, Wash., for thirty days in a recent emergency at that port. When an unprecedented drought cut off the water supply to turn the turbines in the municipal hydroelectric power plant, a distress call to the Navy brought the electric-driven aircraft carrier *Lexington* to the rescue.

With the *Lexington* anchored thirty feet from the dock, twelve cables were strung to the ship and connected to 180,000-horsepower generators. The other end was switched into the city's power system, and the vessel's dynamos set humming. Electric current sped through the cables to aid the city plant's supply, and the city's main industries, many of them shut down for lack of power, quickly swung into action. The novel hook-up continued for about a month, until rain and melting snow restored the water level behind the city dam.

Easily equal to the task was the *Lexington's* electric power plant; any one of its four generators alone was capable of supplying the current needed by the city. At full power the warship's plant could supply the power needs of a city twice the size of Washington, D. C., Navy officials estimate. It would carry the simultaneous load of fifty heavy electric trains, or would light more than 6,000,000 fifty-watt electric lamps. Full power is used to drive the ship at its high speed, which is estimated at approximately forty miles an hour—almost as fast as the average railroad express train.

Rhythmic Noises Speed Up Workers' Output

EFFICIENCY-experts are turning to music to aid modern industry, and manufacturers may soon find it to their advantage to put brass bands and perhaps entire symphony orchestras on their pay rolls. Rhythmical sounds produced by various instruments in time with the movements of workers during a recent experiment in an English packing warehouse is reported to have increased their output twenty percent. Production dropped sharply when the sounds were "jazzed up" so as to be out of time with the motions of the factory hands. A similar experiment in a spinning mill is said to have increased output fifteen percent.

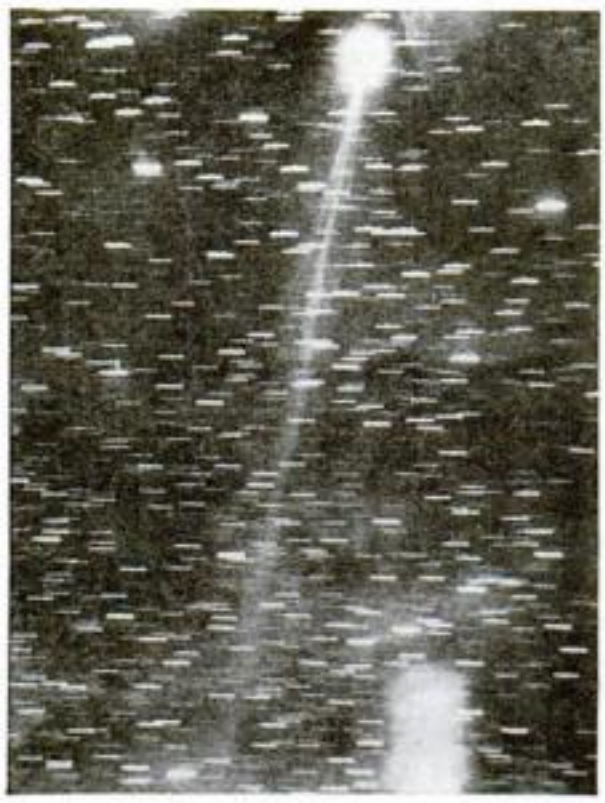
Many experiments of this kind have been made in the United States. The Bush Terminal Company last year installed a radio in its offices at Brooklyn, N.Y., and officials advocate the tuning-in on jazz music because they have found it speeds up the work of the typists (P.S.M., Feb. '29, p. 62).

Nation-Wide Survey to Fix Exact Locations

TO FIX on maps the exact position of every portion of the United States' vast territory is the aim of the United States Coast and Geodetic Survey. The entire 3,000,000 square miles of the country will then be brought within the inclosure of the Government survey's great triangulation system. So William Bowie, chief of the geodesy division of the survey, recently reported to the National Academy of Sciences.

Geodetic surveying, the most accurate of all surveying, deals with large areas and takes into account the curvature of the earth's surface. The territory to be surveyed is divided into several triangles and the arms of the triangles calculated. By continuing the process until the whole area is covered with a network of triangles, the location of all important points throughout the country can be accurately determined. This is known as the

triangulation system. Government survey stations now dot the countryside all over the United States, Canada, and Mexico. The central station is at Meade's Ranch, Kansas.



The Wilk Comet Parades before the Telescope

THE latest of the heavenly bodies to have its picture taken by astronomers is the Wilk comet. The above is a three-time enlargement of the original photograph taken recently at the Yerkes Observatory, Williams Bay, Wis., by G. van Biesbroeck.

The comet's tail, starting as a sharp spike from the side of the comet opposite the sun, spreads out in a stream of star dust that gradually fades. The central beam carries straight on over a length of two astronomical degrees, or a mere million miles. The countless white stripes across the picture represent stars and their changing positions during the long exposure of the plate. A comet's tail races along ahead, proving that its material is repelled by the sun after being ejected from the whirling mass. Comets travel in long ellipses, sometimes retracing their paths. The famous Halley's comet has made three appearances since 1682.

How Much Do You Know about Physics?

TEST your knowledge with these questions, chosen from hundreds asked by our readers. Answers are on page 143.

1. **Would it be possible to siphon water from an elevation of 1,000 feet over an elevation of 2,000 feet high into a valley at sea level?**
2. **Does gravity act in a partial vacuum?**
3. **Is it easier to swim in deep water?**
4. **How is the horsepower of an engine measured?**
5. **If water boils at 212 degrees, how could the thermometer on my hot water boiler register 220 degrees?**
6. **How can I measure distance by sound?**
7. **What happens to energy used up in friction?**
8. **Is there any substance that will insulate against magnetism?**
9. **Why does a diamond sparkle more than a piece of glass cut and polished in the same way?**
10. **How does a fireless cooker work?**

New Composition Hard as Flint, Flexible as Paper

Dr. Hal T. Beans, of Columbia University, testing toughness of flexible phonograph records made of new chemical composition.

A REMARKABLE chemical composition recently developed promises, among other things, unbreakable phonograph records that can be stamped with the speed of a printing press and sold like papers on the news stands, as well as a fire- and waterproof varnish substitute, especially valuable on airplanes.

Developed by Dr. Hal T. Beans, professor of chemistry at Columbia University, this composition represents the climax of a search conducted by chemists for years to find a material of such flexibility and toughness. A thin film of the stuff, so tough that a hammer blow will not break it, is as pliable as a sheet of paper. It is really a synthetic resin, without taste or odor, in appearance a clear amber substance with a polished surface. Hardening quickly from the liquid state, it is highly resistant to heat, and is said to be ideal for molding and stamping processes. Even matrices for casting metal type can be made of this composition. As a liquid it is noncombustible, and accordingly is useful as a coating for the nonmetallic parts of airplanes, on which it can be sprayed.

It may even invade the world of the "talkie," replacing the fragile material of which talkie disks are now made. If the claims of its producers are justified, the new compound may effect a drastic price reduction in various manufactured commodities.

"Ice Fans" Cool French Railway Coaches

IN FRANCE, hot, stuffy railroad trips are to be banished next summer by artificially cooled cars. In preliminary experiments last year the first of these novel trains, on a trial run of several hours from Paris, maintained a temperature of about sixty-eight degrees Fahrenheit despite the heat.

A compartment at the end of the car holds tanks containing 500 pounds of ice. Chilled air drawn between the tanks is blown by a fan through a duct running the length of the car, escaping from outlets into the passenger compartments. Wooden latticework on the roof of the car insulates it from the hot sun.

The railroad developing the system plans to "refrigerate" all its coaches, regardless of class.

"Spinning Wheel" Bottles German Soft Drinks

NO, NOT an old-fashioned spinning wheel, but a "bottling" wheel is the strange contraption pictured below. It is used for putting corks into bottles of fruit juice concocted in a nonalcoholic brewery in the province of Thuringia, Germany. Evidently there are other drinks in Germany besides beer, as the making of tasty prohibition beverages from fresh fruits is a process of some importance in this district.

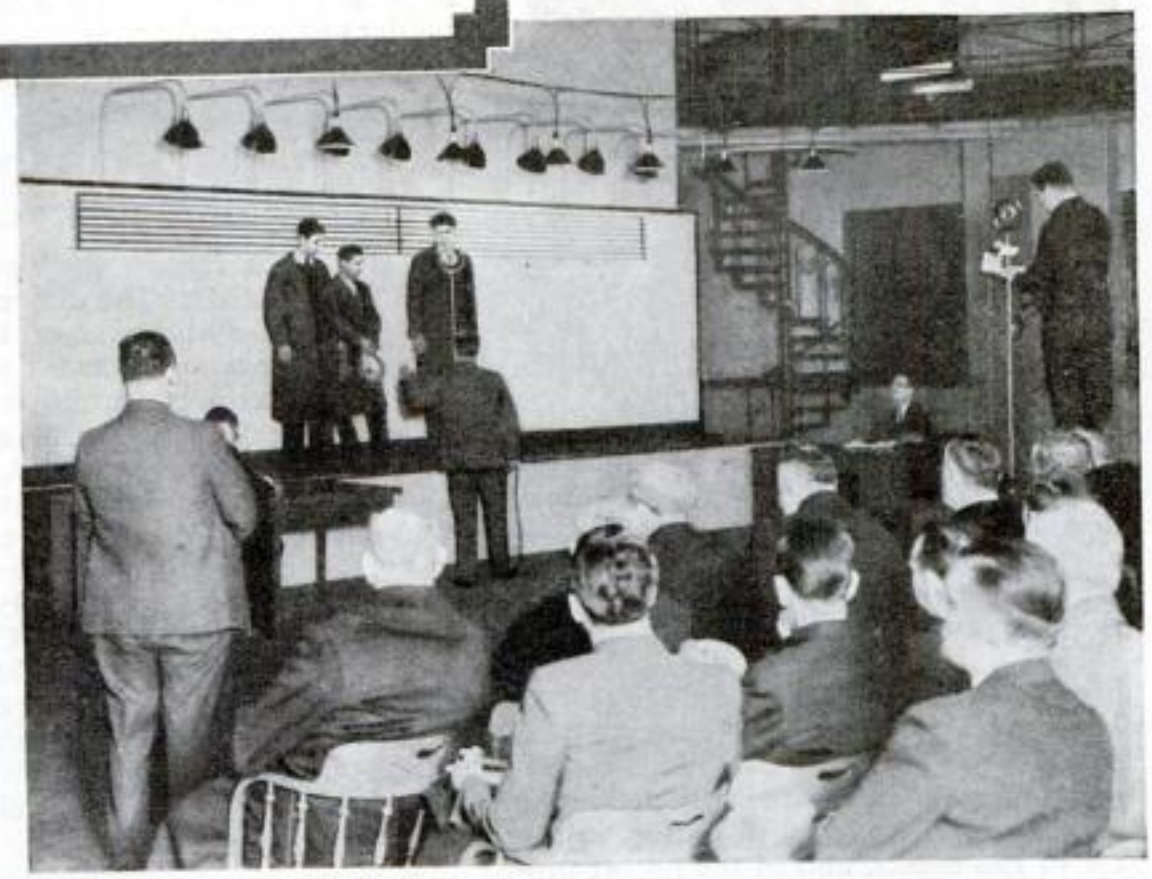
The hub of the wheel for bottling the finai product has cups resembling electric light sockets to receive the necks of the bottles. From the rim of the wheel springs press down on the bottoms of the bottles to effect the sure plugging of the corks. Thus the bottles themselves form the spokes of the wheel.

Novel "brewery" wheel used in corking bottles of unfermented fruit juice in Thuringia, Germany.

A scene at the new Police College established by the City of New York for scientific training of officers of the law—"rookies" receiving instruction in scaling walls, with the aid of ropes, to save life at fires.

A College for Police

An officer of the New York emergency squad demonstrates to students the loading of tear gas bombs, the latest chemical weapon employed against criminals. These particular bombs were shipped to the State Prison at Auburn, N. Y., by airplane during the recent convict outbreak.



The morning line-up of criminals in New York police headquarters. As they stand on the platform, blinding lights above their heads prevent their seeing detectives examining them.

Stanley Gorman, ballistic expert of the Police College, at work in his laboratory. Here bullets, examined under the microscope, are identified by the "fingerprint" marks which the weapons that fired them made.

The photograph at the right shows future police officers receiving instruction in the handling and shooting of service pistols on the range of New York City's Police College.

PROGRESS AND DISCOVERY

This oxygen apparatus, being described to the class, is meant to save buried miners. Left: The rescuers, after reviving a victim, are ready to put him on a stretcher.

Equipped with gas masks and armed with pickaxes, the rescue squad will face mine gases.

School for Rescue Squads in Abandoned Mine

A NEW kind of life guard, which instead of saving men from drowning will learn how to rescue them from being buried alive, is now undergoing training in the coal mining district of Upper Silesia, on the German-Polish frontier.

Here a mine long deserted is being utilized for the experiments in life-saving. Young mountaineers, whose occupations may carry them into hazardous underground passageways, are instructed in the working of the oxygen pulmotor, in the use of gas masks, and in the proper procedure for getting a man out of the subterranean tomb in which he may be buried alive or have his exit cut off by landslide or other accident.

Pilot Launches Airplane from Speeding Auto

TAKING off from the roof of an automobile speeding at fifty miles an hour was the novel feat performed recently at Old Orchard, Me., by a nervy airplane pilot. The stunt demonstrated that this new way of catapulting an airplane into the air is at least feasible, if not altogether soothing to the nerves of the average passenger who is not thrill hungry.

Some months ago a similar attempt to launch an airplane from the roof of a fast train failed, the airplane being wrecked in the take-off.

In the Maine attempt the machine was perched on a frame lashed to the top of the car and a device, operated by the pilot, released it when the car had attained sufficient speed. A curious incident was the pilot's discovery that he could steer the automobile by swinging the rudder of the airplane.

Is There a Limit to the Size of Hailstones?

HAILSTONES remain a "size" puzzle even for scientists. The difficulty lies in verifying the statements of those who claim to have seen enormous stones fall. The most convincing record is that of a stone falling July 6, 1928, at Potter, Nebraska. This stone, it is said, measured seventeen inches around. Some of the stones falling at that time were described by eye witnesses as being "as large as grapefruit." On August 1, 1929, large hailstones fell near Hartford, Conn., and did $1,250,000 damage to the tobacco crop. These stones were larger than hen's eggs, according to reports and photographs taken at the time.

In 1914 two missionaries claimed to have seen ten-pound stones fall in China. In 1925 a German cigar maker of Heidgraben, near Hamburg, asserted that a four - and - one - half - pounder crashed through the tiled roof of his house. A century ago houses were said to have been crushed under "blocks of ice" in a storm that swept through the town of Carloza, Spain, on June 15, 1829.

The hen's egg, in the right hand, is dwarfed by these extra large Connecticut hailstones.

Studies Eskimo and Indian to Trace Kinship

SOME anatomical facts which have lately been gathered in Alaska by Dr. Ales Hrdlicka, of the United States National Museum, may throw new light on the problem of the relation of the Eskimo to the Indian. Dr. Hrdlicka recently reported to the National Academy of Sciences that he had measured 200 full-blood Indians and Eskimos, from head to foot. The results show, according to Dr. Hrdlicka, "that there is a growing warmth for the hope that before long it may be possible to say something definite about the origin of the Eskimo and his relation to the Indian."

The expedition also did much to clarify ideas with reference to the ancient migration route of the first people on this continent. That the Eskimo may have wandered from the coasts of Siberia at a time when there were land linkages between Asia and North America has long been a favorite theory to which support is given by the wide span of the Eskimo's habitation. There are seven groups of Eskimo scattered over the 5,000 miles of territory that lie between East Greenland and Asia. What mysterious links bind these widely separated tribes into a chain may soon be discovered in further investigations by Dr. Hrdlicka.

Father Hubbard celebrates mass in the wilderness beside Katmai Beach at the start of the trip to the volcano.

Priest Explores Alaskan Volcano

FOUR adventurers who penetrated a wild region of Alaska where smoke and steam curl from thousands of holes in a valley's floor returned not long ago with photographs and scientific records of one of Nature's curiosities—the "Valley of Ten Thousand Smokes."

The leader of the band, Father Bernard Hubbard, geologist of the University of Santa Clara, Calif., is known as "the Glacier Priest" for his previous successful conquest of the Taku Glacier in southern Alaska (P. S. M., July, '28, p. 49). His companions in the new expedition were "Red" Chisholm, former Santa Clara football star, and Frank Klatt and Charles Bartlett, students.

Leaving Katmai Beach, on the Alaskan Peninsula, the party climbed Mt. Katmai, a slumbering volcano, and entered the million-acre valley beyond.

Preparing a cache of food for the return trip. It was hauled to the top of a tree where it would be safe from marauding animals.

Below: Standing on the pinnacle of Observation Mountain, Father Hubbard surveys the wild country and picks out a likely trail to Katmai.

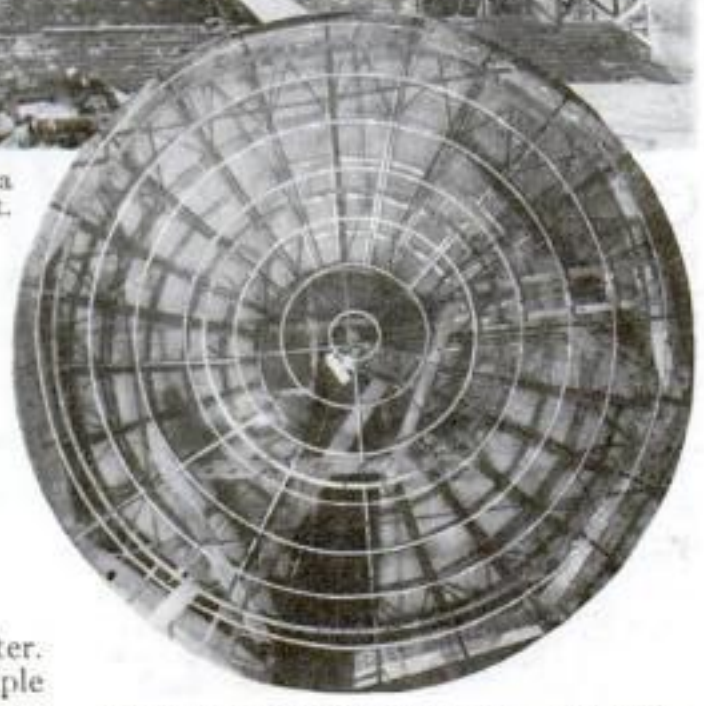
Steam heat on a cold day. Frank Klatt, student explorer, warms his hands at one of the fumaroles or steam jets spouting from the floor of the "Valley of Smokes."

Left: At their goal, Father Hubbard (right) and "Red" Chisholm view the Valley of Smokes from the summit of Novarupta, a 3,000-foot slumbering volcano, one of the six within the region.

PROGRESS AND DISCOVERY

Chicago's Planetarium Nearing Completion

The new planetarium under construction on a man-made island off Chicago's lake front.



Looking up into the domed roof—the "night sky" on which images of stars will appear.

THE world's finest example of a planetarium, an astronomical theater on whose domed ceiling are projected the relative motions of the heavenly bodies, is nearing completion on an artificial island off Chicago's lake front. Inside the building spectators will sit in circular rows about a multiple projector which through 119 lenses will cast the images of stars and planets on a vaulted screen ninety feet in diameter. By altering the slides behind the multiple lens projectors, it will be possible to show 4,500 stars, each one revealed in its natural size, brilliance, and location in the heavens.

Planetariums similar to the one in Chicago have been built in a dozen cities of Germany, and others are undergoing construction in Italy and Soviet Russia (P.S.M., Jan. '29, p. 130).

Water Pumped Uphill to Keep Dynamos Busy

BECAUSE of the demand for electricity during the day, ordinary power stations have to install expensive dynamos that are not used to full capacity during the night. A German power plant near the town of Niederwartha has adopted an ingenious plan to keep its dynamos running at full efficiency all the time. During the night, when the demand for electricity is low, the surplus power is used to pump water up a hill into large storage reservoirs. In the daytime the water is allowed to run downhill again, running a water turbine and dynamo and furnishing additional electricity when the need for it is greatest.

Analyzes Third of a Drop

ONE 1,500th of a fluid ounce of chemical, or about one third the volume of a drop of water from a medicine dropper, recently yielded its secrets to a chemist in a New York City demonstration. It was the first public exhibition of a new way of testing minute quantities of chemicals. Formerly much larger samples were required for analysis.

In the test Dr. Joseph Niederl, of New York University, broke a fine glass tube containing the minute quantity of liquid in a vessel containing mercury and heated it until the liquid became a gas. As the gas expanded it forced off an amount of mercury equal to its volume. By figuring the temperature at which the gas vaporized, and its volume, the molecular weight was determined.

A similar method of microanalysis was used by Dr. Niederl recently to test a substance developed as a rubber substitute by a New York laboratory.

Predicting Thunderstorms

BY MATHEMATICAL wizardry a new kind of chart known as a "tephigram" is said to predict thunderstorms from five to six hours in advance. It shows the amount of energy available in the atmosphere for release in the form of a thunderstorm, as wind or otherwise. A balloon equipped with weather instruments is sent aloft and the temperature, pressure, and other conditions of the air at various heights found. These data are expressed in curves drawn on the ruled paper of the "tephigram," from which the time of a probable thunderstorm is revealed. The method, announced by C. M. Alvord and R. H. Smith, of the Massachusetts Institute of Technology, is expected to be useful to warn aviators of storms.

Finds Protons Play Dual Rôle; Wins Prize

A SCIENTIFIC "Bolshevik" won a $1,000 prize the other day for upsetting one more of the fundamental ideas of classical physics. Prof. A. J. Dempster, University of Chicago physicist, proved that a proton, the core of an atom, leads a dual existence as both a tangible particle and an intangible sort of wave motion. For the feat he received the annual award offered by the American Association for the Advancement of Science.

His discovery now makes a pretty mess of the attractively simple picture of the atom that nineteenth-century physicists had built up. It was thought that an atom, or smallest possible complete piece of a substance, was made of two perfectly tangible things, both charged with electricity. One, the core, or "proton," was positively charged; the other, consisting of one or more electrons spinning around the core, was negatively charged—and that was that. But in 1927 two research physicists at the Bell Telephone Laboratories, C. J. Davisson and L. H. Germer, partly spoiled this picture when they found electrons not only were particles but that they also behaved like waves.

To find whether protons, too, had a wavelike nature, Dr. Dempster used a device like that which, in other hands, first showed X-rays to be true waves. This was a crystal of a mineral known as calcite through which he shot a beam of protons, in this case electrified cores or nuclei of hydrogen atoms, in a vacuum. A photographic plate caught wave patterns formed by the grating of molecules in the crystal, proving the new theory. Vibrations of the atom cores that produced the waves were a million times faster than those of light waves.

How protons and electrons can be waves and particles at the same time, Dr. Dempster says, is "perhaps the greatest problem now confronting physics."

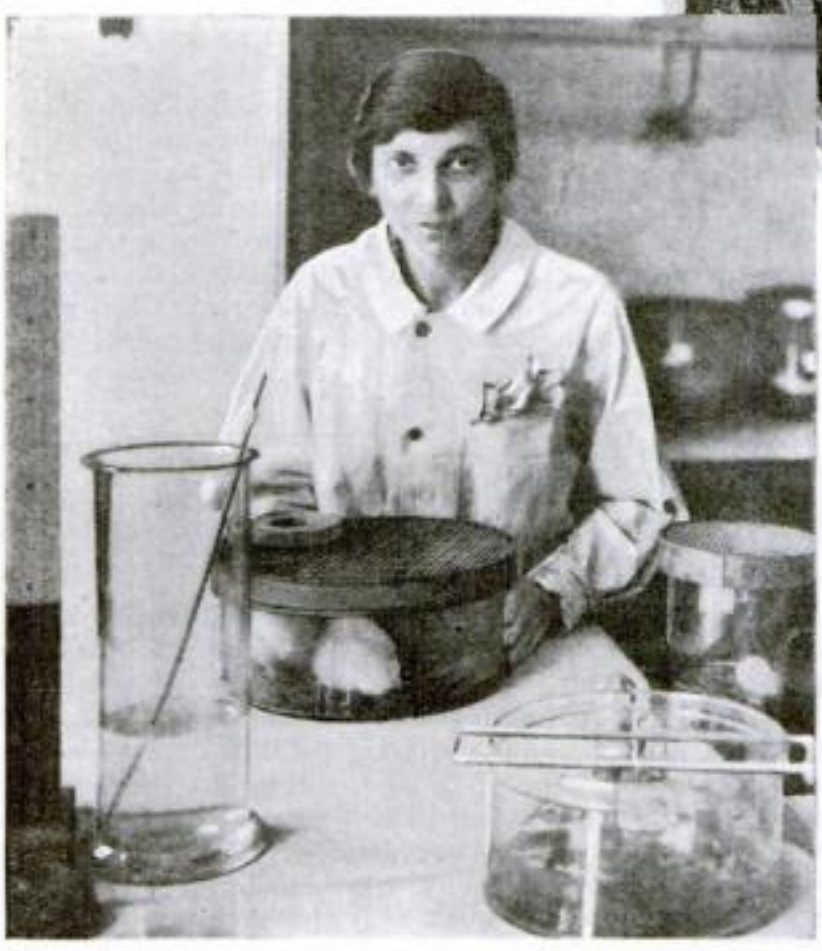
Prof. A. J. Dempster, science prize winner for discoveries about protons, in his laboratory.

Boring a Tunnel 9,000 Feet Up

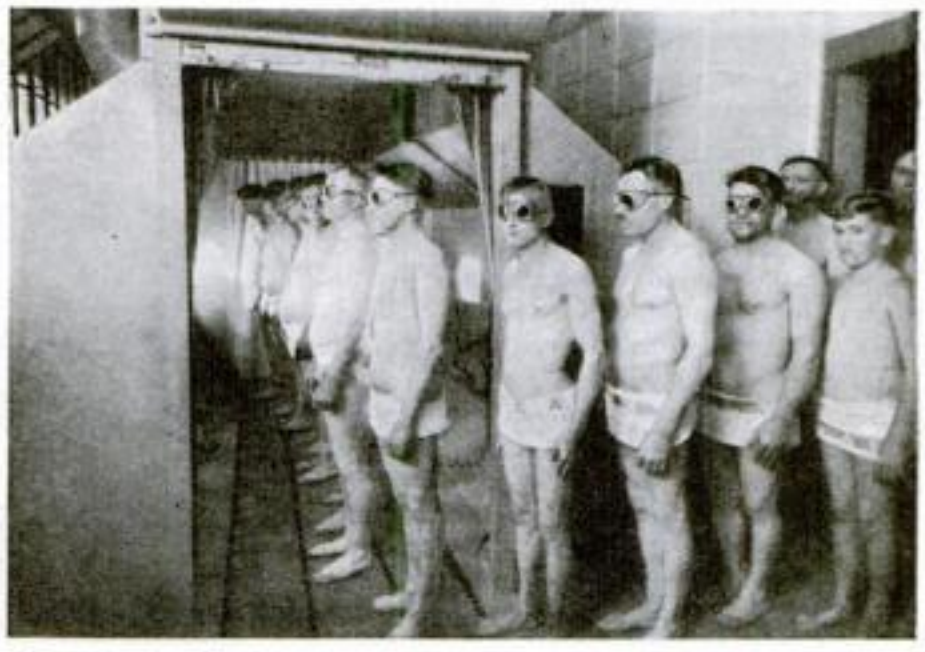
Completing a cogwheel railway up the Zugspitz, highest peak in the German Alps, workmen are driving a tunnel into the mountain at a height of 9,000 feet. Each day they travel to their job by cableway. Above: The lofty tunnel entrance, looking from within. At right: A view of the entrance in the mountain wall.

Through the Rocks. This view within the Zugspitz tunnel shows a crew of workmen biting in the wall of solid rock with a pneumatic power drill. Notice the horn at the waist of the man at the extreme right. He uses it for signaling to other crews.

"Taken for a Ride." Two of the workmen starting the descent by aerial cable car from the mouth of the railway tunnel in the Zugspitz. The railway will go nearly to the 9,722-foot summit.



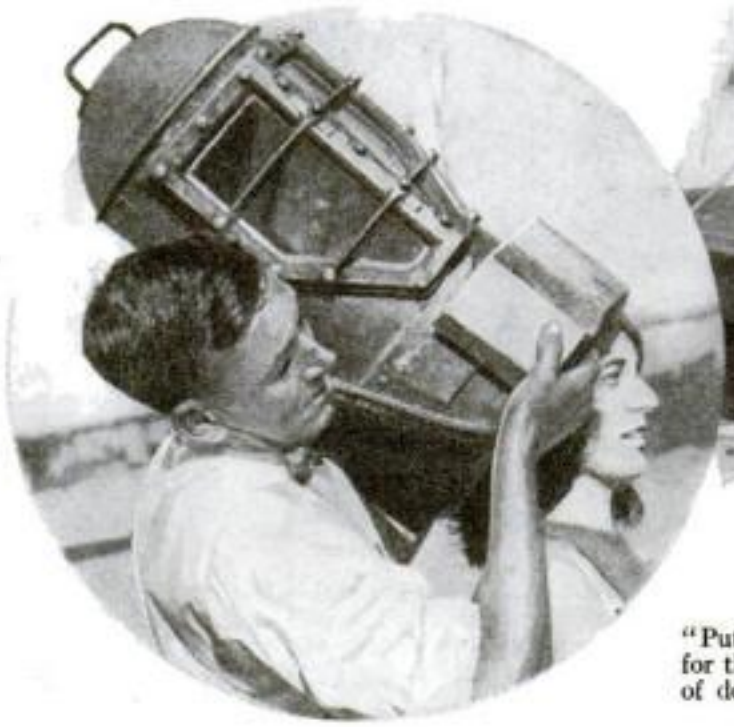
Hunts Leprosy Cure. The only woman scientist from America who is now doing research work in the famous Pasteur Institute, Paris, France, is Adele Cohen, of Newark, N. J. At present she is searching for a serum for the cure of leprosy.



Sun Baths for Miners. Men who work in the depths of an Idaho mine get their share of sunlight in this special solarium. The miners, stripped and wearing protective goggles, stand upon a moving platform which takes one minute to travel in front of a battery of ultra-violet lamps.

PROGRESS AND DISCOVERY

Ocean's Floor Is Classroom for Undersea Zoologists



"Put it on," says Hazel Heinrich, left, ready for the helmet and study. Above: The students of deep-sea life come up for air at intervals.

IN A sea-bottom classroom, with shimmering green water for atmosphere and divers' helmets for windows, the pupils of the marine zoology class of the University of Miami go to their work. Making semi-weekly trips to the floor of the ocean, the students study the rich variety of sea flora and fauna, and occasionally bring choice specimens up with them. Giant starfish, sea polyps, coral beds, sponges, and innumerable other interesting sea animals are among the objects of study. The students are clad only in bathing suits, and are equipped with diving helmets that fit snugly over the head and rest on the shoulders. Air is fed to the submarine pupils by tubes leading to the helmets from the surface. The professor, down there with them, jots down notes and instructions by means of a slate and pencil.

Bees' Tongues May Yet Prove Acquired Traits Persist

FRESH evidence of the inheritance of acquired characteristics in animals, one of the major unsolved problems in biology, has been discovered by Dr. W. W. Alpatov, formerly of the Zoological Museum of Moscow, Russia, and now connected with the Institute for Biological Research, Baltimore, Md.

In the course of a microscopic survey of the measurements of insects, particularly Russian and American bees, the zoologist set himself the unique task of measuring the length of their tongues, the implement used by the creatures in gathering honey. He found that in Russia the length of the bees' tongues increases as one travels south, the longest-tongued bees known to entomology living in the Caucasus, the southeastern corner of European Russia.

At the same time, his investigation showed that the red clover, in which that country abounds, carries its honey so deep down in its blossoms that most other types of bees cannot reach it. The conclusion was that the Caucasian bees were forced to develop longer tongues to reach the honey, and handed the new feature down to their offspring, thus furnishing a striking example of environmental adaptation.

The late Dr. A. E. Verrill, prominent Yale University zoologist, found in Hawaii a species of crayfish whose tails had become twisted in a direction opposite to normal as a result of having had to adapt themselves to different rock formations, and whose offspring had inherited the new characteristic.

Machine Measures Thought but Is No Mind Reader

THOUGHTS, as well as actions, can speak louder than words, according to Dr. Milton Metfessel, of the University of Southern California, when they are hitched up to an ingenious device he has just invented. Those thinking processes which go on so silently within people's heads are, he says, actually the expression of powerful forces at work, nerve impulses flashing from one end of the brain to the other along complex networks of nerve fibers. Scientists before probably have dreamed of measuring the impulses which constitute familiar thoughts, but Dr. Metfessel claims he is the first to realize this dream.

In order to "put the meter" on thoughts, he has an individual stand before an electric amplifier and places a pair of electrodes on the tongue. The electrodes, he asserts, capture the delicate electric fields set up by the nerve impulses from the brain and relay them to the amplifier, where they may be reproduced as sound in a loudspeaker, or as light waves which may be photographed.

Thought impulses, picked up by electrodes laid on the tongue, are reproduced as sound.

Blue Aniline Dye Now Used in Fight on Cancer

INJECTION of small quantities of an aniline dye known as isamine blue into the blood stream is a new procedure in cancer treatment developed by specialists of the Charité Hospital in Berlin.

The dye is absorbed by the cancer cells rather than by the cells of the body's healthy tissues. Several advantages are claimed for the new technique. The surgeon's work may be facilitated by the blue color of the dyed cancer, indicating the margin between the diseased and normal tissues, and the dye may also show small cancer-affected areas likely to be overlooked. In radium treatment, the dye is believed to increase the tendency of cancer cells to absorb, and be destroyed by, radium rays.

Dora Peterson proudly displays specimens gathered from far below the rolling waves.

Along the Airways of the World

Lindbergh's new plane. With 450 gallon gas capacity, it leads all pleasure craft in range.

Curtiss Helicopter Will Soon Get Try-Out—Army Plane with Full Load Reaches 30,000 Feet

NEWS that a new type of helicopter, an airplane that can rise straight up, is nearing completion at Garden City, N. Y., at last definitely confirms a report published in Popular Science Monthly some time ago (Feb., '28, p. 43) that the Curtiss airplane firm was building one. At that time officials of the Curtiss Aeroplane and Motor Company declined to comment upon this report, significant as the first venture of a prominent aircraft concern into helicopter design. Now, however, it is known that the odd craft will soon have its first try-out, and a few details of its construction have become known.

Within the steel chassis are a 425-horsepower radial motor and seats for two passengers. Above the cabin four wings, somewhat resembling those of the "autogiro" or "windmill" plane (P. S. M., Nov. '29, p. 43), revolve. Unlike the last, however, they are power-driven, and their combined lifting force is expected to raise the craft bodily into the air without a preliminary run. One important advantage of a craft of the helicopter type is the small space it requires for landing and taking off, making it possible to use back yards and roofs for landing fields.

No helicopter as yet has reached the commercial stage, although several have made more or less successful flights.

Recently a helicopter designed by the Italian inventor, Vittorio Isaaco, was completed in England and delivered for tests to the Air Ministry. Like the new Curtiss machine, it resembled the "autogiro" with its "windmill" planes, but has individual motors on the forward edge of each of the revolving wings.

Marine Corps flyers at San Diego, Calif., are trained by this device to trust their indicators, instead of their senses, for direction and balance. With his head in the box the student is whirled around and discovers himself differing from the instruments, which are right.

Plan Nine-Day Air Service from California to Japan

Nine-day flights from California to Japan by airship are now planned by a western air transport company. It is a subsidiary of the Goodyear-Zeppelin Corporation, which is now building the first of two super-airships for the Navy.

Three other airships of equal size, to be built when these are completed, will constitute the air fleet that will inaugurate the new air line to Japan by way of Honolulu and Manila. A dirigible hangar will be erected in California. At Tokio, Japan, there is already a hangar of adequate size. Mooring masts to be erected at other points probably will be collapsible, so as not to be dangerous to other aircraft.

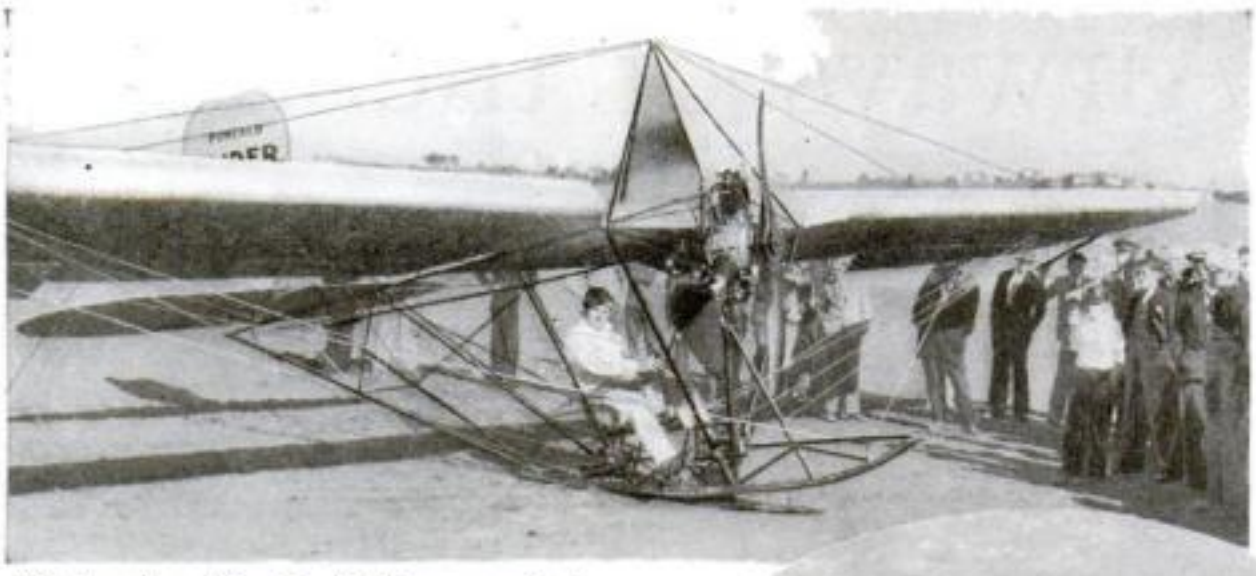
Airships plying the new line are planned to carry 100 passengers apiece. The airship route is not expected to replace, but will supplement, present transportation by steamships.

This striking photo shows the British dirigible *R-100*, which has flown eighty miles an hour.

Army Plane, with Military Load, Climbs 30,000 Feet

Thirty thousand feet above the earth, an Army pursuit plane recently set a new altitude record for a loaded plane of this type. Lieut. Norman H. Ives piloted the plane nearly six miles above Rockwell Field, Calif., carrying "full military load."

Meanwhile, Lieut. Apollo Soucek, Navy flyer and holder of the 39,140-foot American altitude record for all types of airplanes, announced a successful try-out



This is really a glider, though it has an engine installed in it. It makes fifty miles an hour and recently flew from Los Angeles to San Diego, Calif.

of a special oxygen "lung" or mask he has designed to recapture for America the world altitude mark. It worked satisfactorily in a flight to 37,000 feet, he reported. At the time this issue went to press, the world's altitude mark which Soucek hoped to exceed was 41,795 feet, reached last summer by a German flyer, Willy Neunhofer.

Winning the "icicle crown" is a feat of practical utility. Observations of air currents believed to exist at great heights point to the possibility of future air lines at these levels (P.S.M., Dec. '29, p. 26). For military purposes planes with high "ceilings," meaning that they are able to reach great heights, are especially desirable. In aerial combat the plane able to fly the highest has a decided advantage over its foes—a fact which makes the recent record of a loaded pursuit plane particularly significant.

British Dirigible Sets High Speed Record

A WORLD'S speed record for airships is claimed by the newest British super-dirigible *R-100*. In a recent flight near Cardington Airport, England, it attained a speed of eighty-one and one half miles an hour. This speed, reached without using all the engines, is expected to be bettered.

Both the *Los Angeles*, at present America's largest airship, and the German *Graf Zeppelin* have a speed of about seventy-eight miles an hour, although the German ship is said to have reached eighty miles an hour.

New Land Near South Pole Claimed for Norway

NEW territory has been discovered and claimed for Norway by Capt. H. Riiser-Larsen and Lieut. Luetzow Holm, who landed by airplane in a corner of the Antarctic continent hitherto unexplored. Flying from a Norwegian ship, they alighted on the ice between Coats Land and Enderby Land, left the plane, and went ashore to hoist the Norwegian flag in accordance with the established international custom for taking possession of new territory.

The portion of Antarctica they reached is directly opposite the South Pole from Little America, the base of Rear Admiral Richard E. Byrd's exploring party. The coast line coincides roughly with the Antarctic circle; it is about 1,700 miles from the Pole. Enderby Quadrant, the sector of Antarctica which contains the newly-discovered land, extends from 0° to 90° east longitude.

In oval, the $100,000 prize-winning Curtiss Tanager, called the "safest plane." Below: The Tanager clears 35-foot stand with 500-foot ground run.

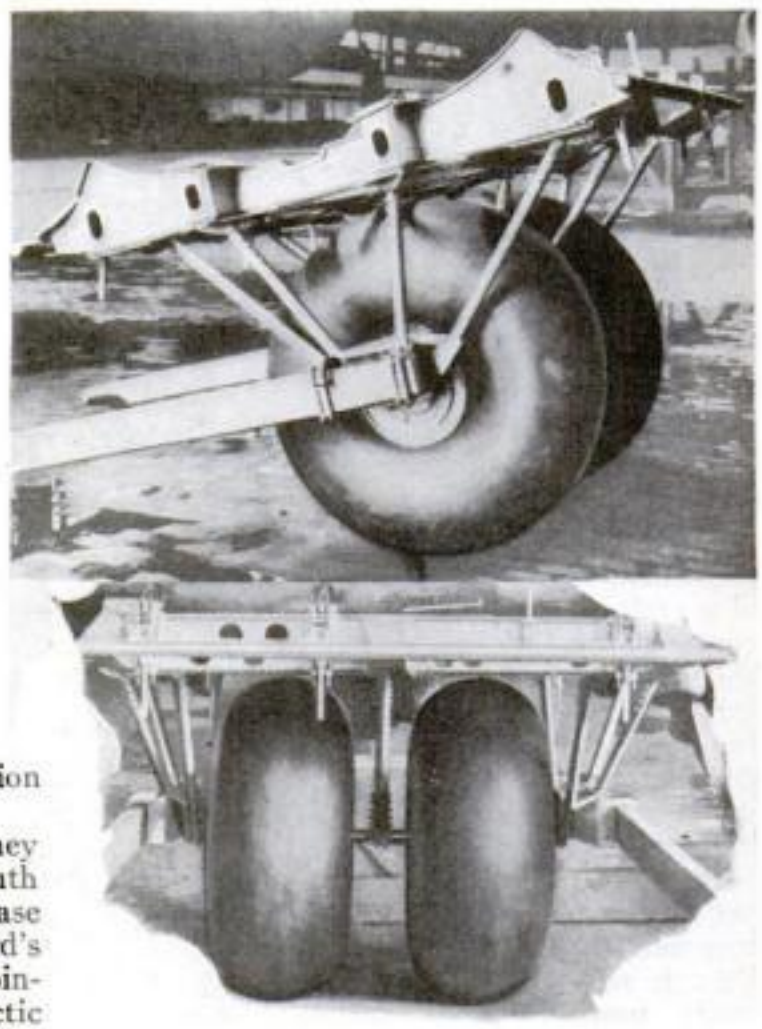
Airplanes Raise Problems in Planning of Cities

WHERE airports fit into cities is now one of the problems of "city planning." How high buildings near airports should be, how airport and transit lines should interconnect, and how air traffic influences city zoning are questions to be considered in a study recently undertaken by the school of city planning at Harvard University.

City planning is not new. One of the first recorded examples is the town of Kahun, in Egypt, which was laid out some 3,000 years before the Christian era. Early Greek and Roman cities were planned along carefully engineered lines, and among more modern cities Bath, England; Edinburgh, Scotland; and Paris, France, are conspicuous in this respect. But just as railroads with their yards and terminals modified city planning—errors in their location costing millions of dollars—so the advent of the airplane brings new problems which city planners are beginning to recognize.

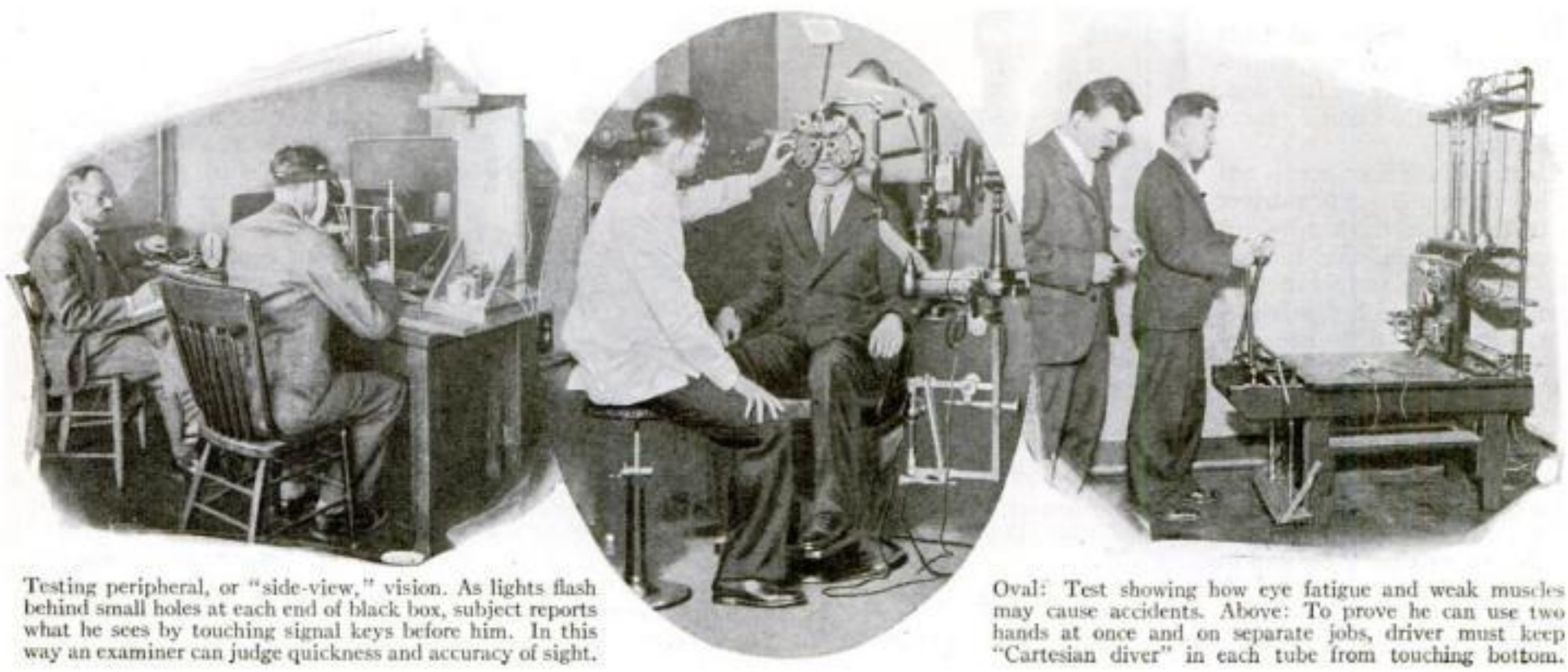
Planes May Bomb Fish

AERIAL scouts may bomb herring from the air, if experiments planned on the north coast of Norway prove successful. Special bombs will stun the fish, and they will float. An observer in the plane can thus detect large numbers of herring.



These giant wheels, designed at the Lakehurst Naval Air Station, will be used on the Navy's dirigibles when at anchor to keep the big ships from tearing the stern as they swing with the change of wind. The tires are 45 by 20 inches, with 20 to 30 pounds air pressure.

Are You Fit to Drive Your Car?



Testing peripheral, or "side-view," vision. As lights flash behind small holes at each end of black box, subject reports what he sees by touching signal keys before him. In this way an examiner can judge quickness and accuracy of sight.

Oval: Test showing how eye fatigue and weak muscles may cause accidents. Above: To prove he can use two hands at once and on separate jobs, driver must keep "Cartesian diver" in each tube from touching bottom.

Yes, If You Are Properly Trained, Says Psychologist, Following Remarkable Tests

By ROBERT E. MARTIN

THE date is 1935, the scene a city traffic court. "You are charged," says the judge, "with reckless driving and endangering the lives of others. Your car, out of control, skidded and went over the curb at the corner of Broad and Main Streets. What have you to say?"

"It wasn't my fault, Your Honor," protests the luckless driver. "The street was wet. The man in front of me stopped suddenly. I had to jam on my brakes, and I skidded."

"It is evident from your statement," the judge replies, "first, that you were traveling faster than was safe under road conditions; second, that you were too near the man in front of you; third, that you don't know how to operate a brake on a rainy day. A fine will not improve your driving. Instead, I sentence you to instruction at the municipal training school for automobile drivers until you know how to drive on a rainy day."

Fantastic? Not according to Dr. Knight Dunlap, Johns Hopkins University psychologist, who advocates teaching, instead of fining, erring motorists. He is in a position to know. As chairman of its division of anthropology and psychology, he recently organized and conducted for the National Research Council, at Ohio State University, a unique program of psychological tests for automobile operators—the first of their kind ever made. Novel mechanical devices dissected and classified, for hundreds of subjects, the many kinds of ability that safe driving requires.

Automobiles in this country are killing more than 31,000 people yearly and injuring or maiming about thirty-five times as many. Experts are demanding to know why these accidents happen. Why do some drivers have "bad luck?" If some persons are constitutionally unfitted to drive, how can they be singled out and barred from the road?

Plainly, not all accidents are the fault of the driver. Reliable estimates lay a tenth of all smash-ups to defective cars. This cause should be easy to remove. In its "speed-with-safety" plan published in the February issue, POPULAR SCIENCE MONTHLY urges the frequent inspection for mechanical defects of every car, whether two weeks or ten years old. Motor experts, commenting on this plan, stressed in particular the importance of this point. In Pennsylvania, wrote Motor Vehicle Commissioner Benjamin C. Eynon, a recent compulsory inspection showed 3,000 cars either improperly equipped or unfit for safe driving. Unfit cars will now be denied registration—an effective way to clear the streets of derelicts.

But can human failure be prevented? The issuance of licenses, and traffic laws themselves, are concerned with the man who drives. Dr. Dunlap has studied the behavior of the man at the wheel. His conclusions are startlingly unconventional. A man who cannot pass a simple intelligence test, he says, may make an excellent driver. Cripples, with only one arm or leg, may safely drive cars that are properly equipped. Simple, common-sense training in manipulating a car's clutch, brake, and steering wheel is the chief requisite. In other words, the ability to shift gears properly, and not a "hair-trigger" mentality, makes a good driver. The great need is for education and practice in driving. But can psychological tests be directly applied in licensing drivers? Dunlap's answer is "no." Driving a car requires such a peculiar combination of thoughts and motions that it would be unfair to single out certain qualifications—say the quickness of response to a given signal—and use them as a standard of competency. It is better, he concludes, to consider a person's driving as a whole than to attempt to analyze it. To this end a "proving ground" is to be opened at Columbus, O., where experts will observe the mental and physical quirks of motorists

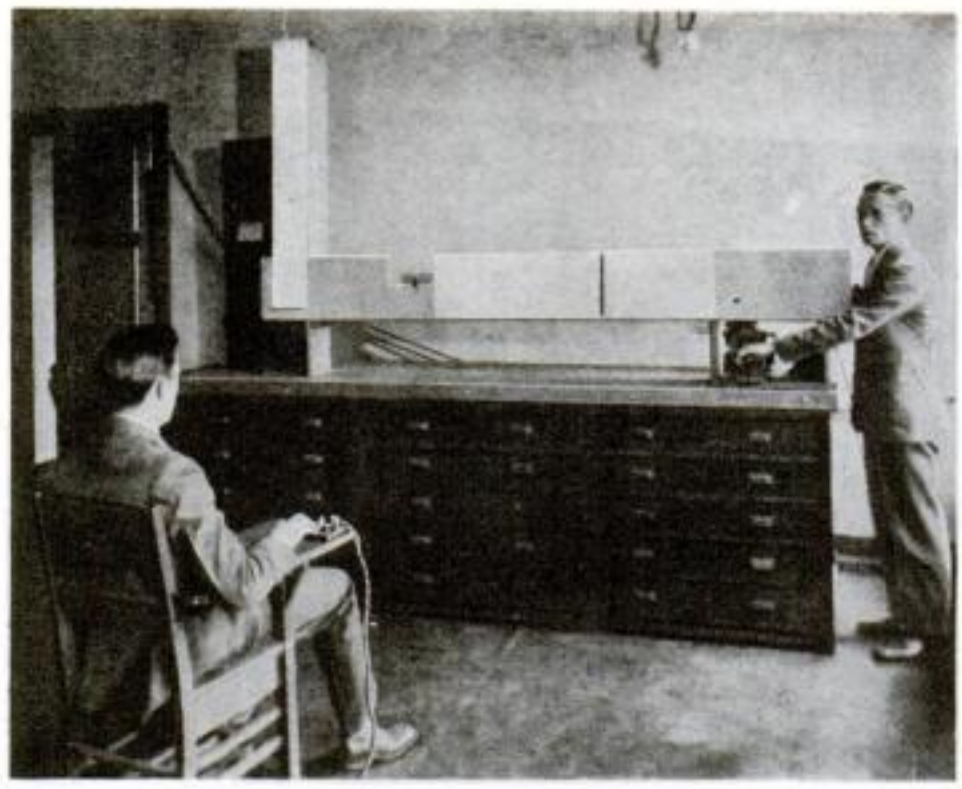
In this unique test of an automobile driver's eye-and-hand coördination an electric peg must be plugged into a hole in a zigzagging disk.

driving real automobiles instead of laboratory models.

Instead of providing, then, a "measuring stick" for aspiring drivers, as some observers had expected, Dr. Dunlap's first psychological tests have explained the way motorist's mind and senses function, revealing little-known facts about driving.

Deafness, for instance, is not such a grave menace in a driver as in the pedestrian, who, for his own safety, should imitate the deer hunter and wear a red coat to distinguish himself.

Bad eyesight, of course, is a more serious handicap. Yet Dr. Dunlap believes this does not cause many accidents. A far greater menace is the man who *can* see but won't take the trouble to look.



Judging distance. A pointer moves steadily, first across opening, then behind screen, when driver must stop it, at stated points, by pushing a button.

Can a color-blind person become a safe driver? Or will he be confused by traffic signals? Dr. Dunlap declares all persons are color-blind—except when they look squarely at an object. To see how a green signal looks to a color-blind person, simply fix the eyes upon a point about fifteen degrees—one sixth of a right angle—to one side of the light. Since an autoist usually observes a traffic signal out of the corner of his eye, because he has to watch pedestrians and other motorists at the same time, signals are designed on the assumption that all motorists are color-blind. Fortunately, there are two colors which a color-blind person can distinguish as well as a man with normal vision—orange-red and blue-green. Signal engineers are adopting these colors.

INGENIOUS apparatus disclosed these and other facts about motorists in Dr. Dunlap's tests for the National Research Council, which were made under the immediate direction of Prof. A. P. Weiss, director of the psychological laboratory of the Ohio State University.

In one test of eye, hand, and foot coördination, subjects sat at the wheel of a dummy automobile with the steering gear, brake, and clutch of a car, and an electric seat that registered the "driver's" movements. Six feet in front, an illuminated chart represented a road.

Along this imaginary highway the subject drove his car. One pointer on the chart showed the course of the test car. Another pointer represented an imaginary vehicle coming toward it. The driver was supposed to steer the test car so as to avoid an imaginary collision with the oncoming car. It was hard to dodge, for mechanism gyrated the approaching pointer as if a reckless driver were at the wheel. If the subject properly applied his controls, an automatic device cut off the power and stopped the pointer. For this the subject received a perfect score. One interesting fact this test revealed was that men are more active behind a steering wheel than women.

A dummy traffic light stood beside the imaginary thoroughfare in some tests, and changing lights gave stop and start commands. Thus the best position of traffic lights for visibility was determined. Also, this test helped to show which drivers were prone to "jump" the red lights.

A "noise barrage" was the means of testing a driver's lack of "emotional stability"—in other words his tendency to fly off the handle or become confused by strange sights and noises. The subject sat in a padded chair, a pair of electrified handles in his hands. These carried a current far too mild to be felt, for the object was to detect the extremely delicate electric changes in the body itself. Suddenly, bells clanged. Lights flashed crazily. Buzzers whirred. A gun cracked, so close that the subject could smell the burning powder. Meanwhile a delicate galvanometer, an electric meter in the next room, measured the subject's ability to keep calm. Few but truck drivers survived this test.

A motorist's ability to judge motion and distance was measured by a pointer that moved across an opening between two screens and then disappeared behind them. It was traveling steadily. The subject was asked to stop it, by pressing a button, when he thought it had traveled a specified distance behind one of the screens. A graduated scale on the pointer's track measured how good a judge of motion the subject was.

Other tests measured a subject's eye-and-hand coördination, his ability to do two things at once, and his heart action. For the first, a subject tried to plug an electrified peg into a hole in a brass disk that zigzagged elusively in front of him. Then he tried to keep two "Cartesian divers," little rubber floaters in separate tubes of water, from touching bottom by manipulating an air pump with each hand at the same time. Finally he ran five steps up and down a special stepladder, so that his heartbeats could be observed.

The main value of such tests is that they provide basic information about motorists that never before was available. How far they can be applied directly in judging any individual motorist's qualifications for a driver's license is a question. That they should be interpreted with caution is emphasized by Dr. Dunlap himself. Quickness of response, he points out as an example, is not always desirable in driving. The man who sets his brakes suddenly may endanger another driver behind him. Thus a simple psychological test to measure a man's speed of action is not alone a sufficient index of his good driving. A more complicated test to measure his speed of correctly deciding what to do, instead of merely acting on snap judgment, is open to the criticism that a man may do one thing in the laboratory and another on the road.

THE best kind of examination for drivers at present, Dr. Dunlap says, is simply a rigorous test for a driver's license such as many states now demand. At least such tests compel the driver to learn something of running a car and of traffic laws. It would be a good thing for an inspector to flunk a few candidates occasionally, just to emphasize that a man must practice thoroughly before he is competent to drive alone. The ideal driver, Dr. Dunlap declares, is the man who acts automatically without having to stop and think.

So the task now before the experts is to develop, with these basic tests as a guide, some way of barring the unsafe driver from the road and giving its free use to all others. Few unsafe drivers are born that way, and the majority can be taught to drive safely, Dr. Dunlap contends. This training in the fundamentals of driving is the present need.

A step in this direction is that of a Brooklyn, N. Y., association of car owners, which recently set aside a $50,000 fund to teach safety measures to drivers and pedestrians. And many organizations throughout the country are recognizing the wisdom of preventing accidents before they occur.

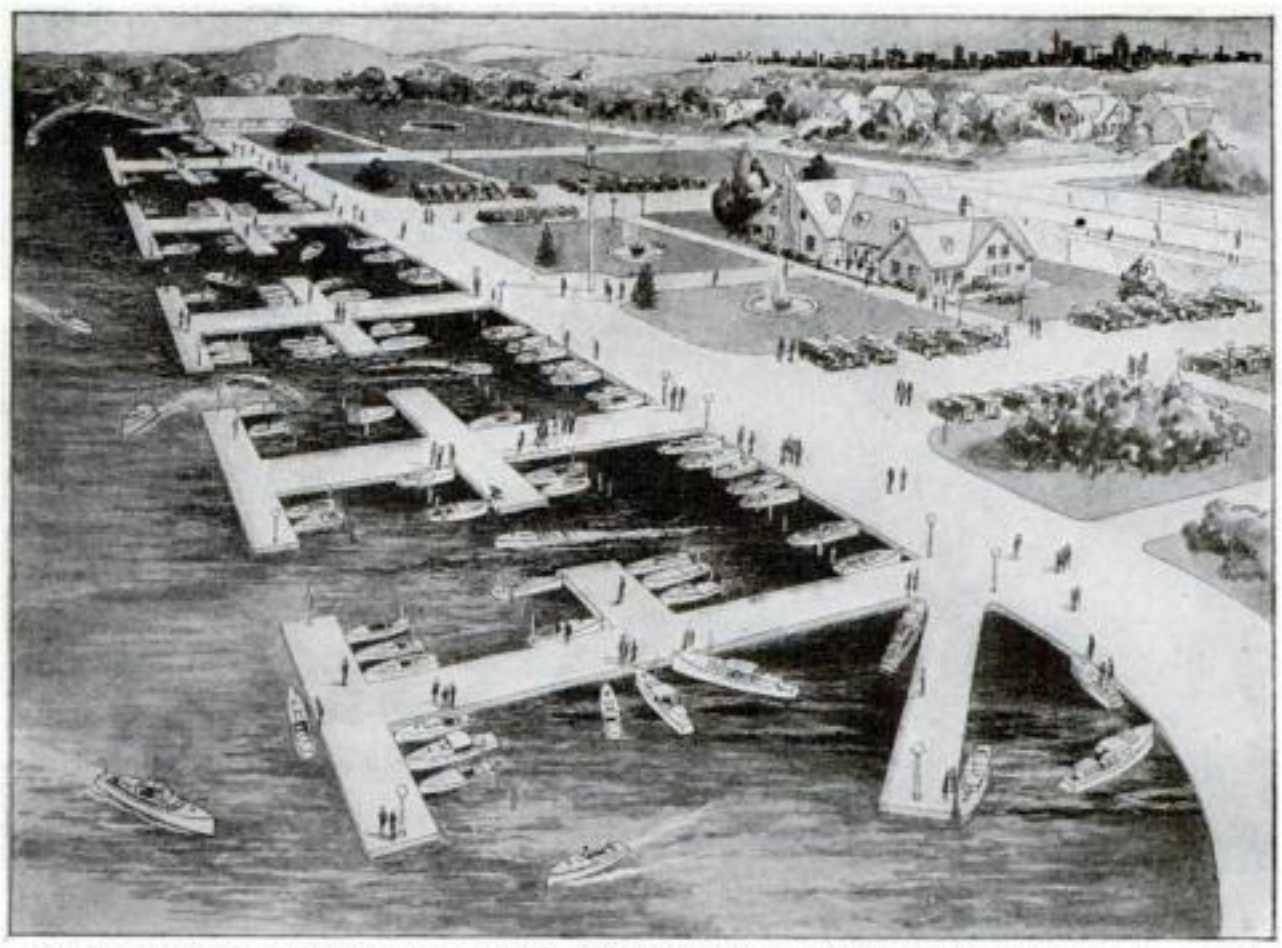
With brake, clutch, and steering wheel, driver shows how he would prevent head-on collision. A pointer represents an oncoming car.

Harbors for Motor Boats

Many towns face big problem in caring for thousands of small craft—Municipal docks, now in operation, are paying returns on investment

By

GEORGE LEE DOWD, JR.



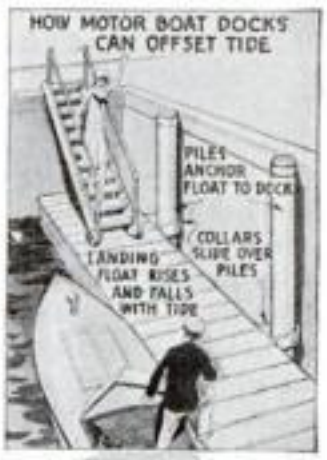
This is a model design for a small boat basin. The T-head docks afford protection from the waves and supply parking space for hundreds of boats. Such harbors are being constructed by several cities.

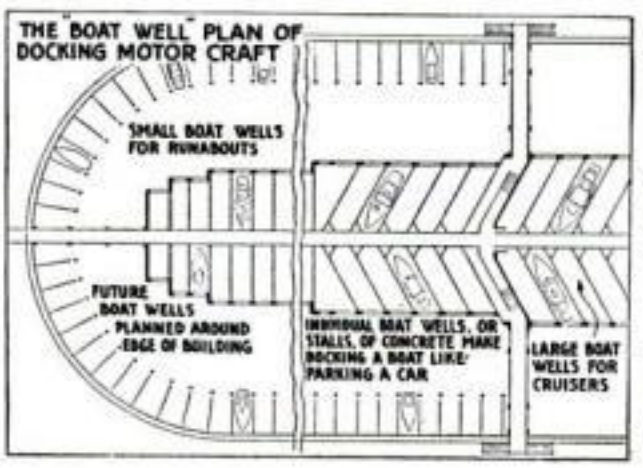
A NEW way of parking motor boats is to be tried in Detroit. Individual "boat wells" of concrete, similar to stalls for automobiles in a garage, are part of a $249,000 structure planned for that city. Cruisers and runabouts speeding up the Detroit River from Lake Erie, or coming down from Lake St. Clair, will put up in these wells, which are leased by boat owners for the year. Already similar privately operated boat harbors offer shelter for water craft in that city.

Thus one city solves a problem that yearly becomes more acute—where to dock motor boats. The United States, with its fine inland waterways, lakes, and sheltered ocean routes, offers splendid routes for motor boats but few places to keep them. In cities especially, where private boathouses are fewer, facilities are often woefully inadequate. Yacht clubs provide mooring for only a few craft, compared with the number that would be used if more harbors were available. The experience of most of the big cities shows that it is a problem for the municipality itself.

Imagine 32,000 motor boats crowded into one of the most densely populated areas in the world and a picture is obtained of the puzzle that confronts New York City, the center, by sheer weight of numbers, of any small boat discussion. Several yacht clubs house a few boats. The rest are docked as best they may be. A harbor built across the Hudson River at Englewood, N. J., by the Palisade Interstate Park Commission, was immediately filled to capacity and now has a waiting list of one hundred boats. The National Association of Engine and Boat Manufacturers, which has made a survey of harbor facilities all over the country, estimates that if New York provided sufficient mooring space its motor boat population would jump at once to 100,000.

Owners could easily commute to the city, as a few now do, and park the boats in slips during the day. The craft would be easily accessible to city dwellers for evening, afternoon, and week-end cruising, instead of being anchored miles from the city.



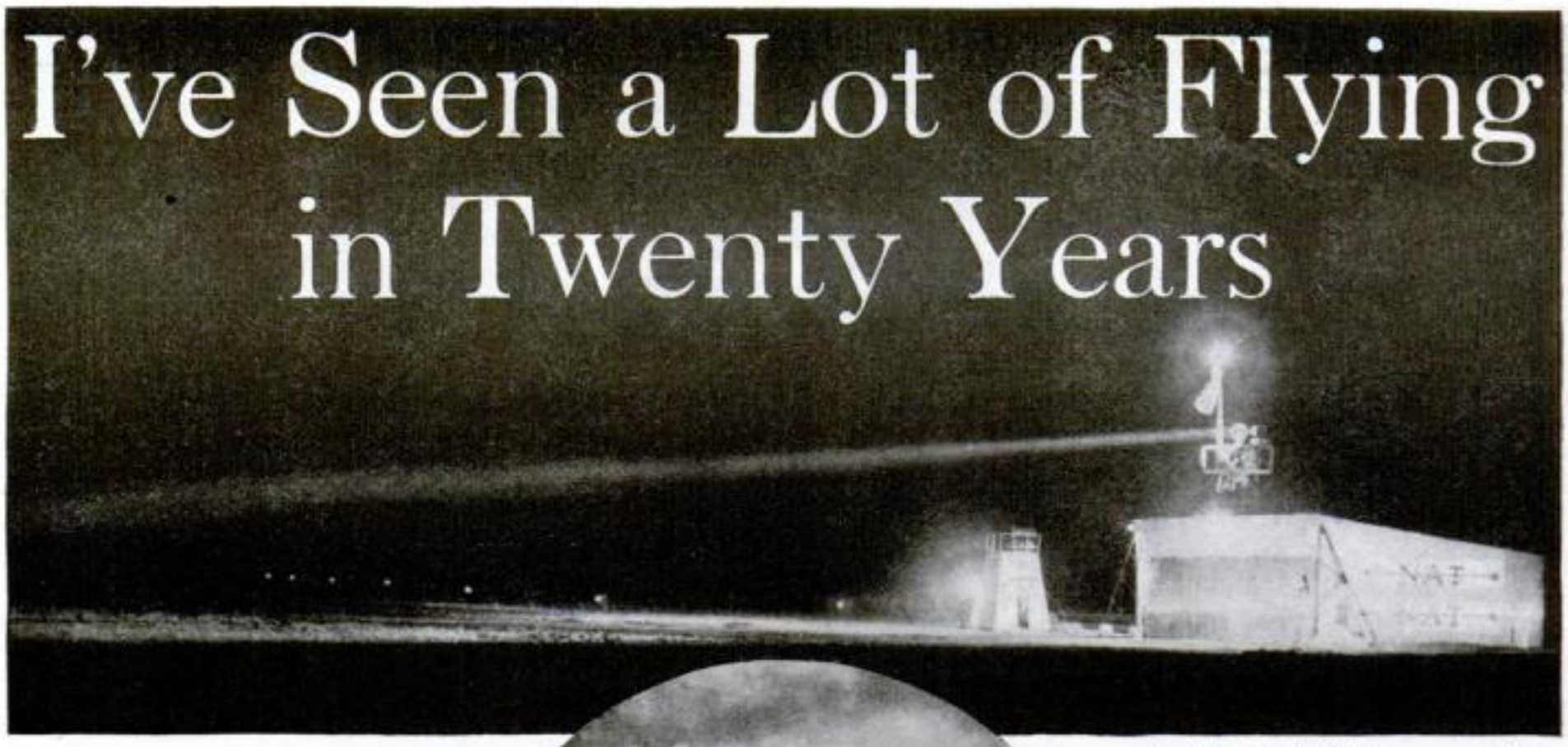


Already New York is awakening to this need. Money has been appropriated by the city to build two small yacht basins in connection with an extension and improvement of Riverside Park, a municipal park fronting the Hudson River. According to Park Commissioner Walter R. Herrick, the Park Department is ready to proceed immediately with their construction as soon as a railroad with tracks in the park area completes its announced project of covering them.

Above are shown, at left, an approved method of mooring small boats in tidewater, and, at right, a diagram of the "boat well" harbor planned for Detroit. The bottom picture illustrates the confusion and congestion at a typical city yacht club landing, in most places the only refuge for small water craft.

MEANWHILE the National Association of Engine and Boat Manufacturers proposes a much more extensive plan—to line the water front from this park northward, for six miles, with a series of docks for small water craft. These would accommodate hundreds of boats through the use of "T-head" piers—so called because of their branching ends on the water side. They would be built on concrete or metal-covered piles which would allow a free flow of water beneath the docks, avoiding accumulation of silt and sand. The river front adjoining the docks would become a promenade. (Continued on page 150)

I've Seen a Lot of Flying in Twenty Years



A chain of aerial lighthouses stretching from coast to coast now guides the night flyer. Left: Curtiss Robin plane. Compare it with its ancestor below.

Veteran Pilot Recalls Dare-Devils and Their Flights and Tells of the Narrow Escapes When Airplanes First Flew

By
ASSEN JORDANOFF

IT IS nearly twenty years since I climbed into my first cockpit. While I have been traveling the skyways, flying fields have developed from bumpy cow pastures to concrete runways; airplanes from lumbering box kites to winged bullets; hangars from flimsy canvas tents to huge structures of concrete and steel.

The other evening, I looked over an old scrapbook I began keeping in 1910. Yellowed clippings told of a cross-country flight of 106 miles "electrifying Europe"; of Henry Farman landing after eight hours in the air amid "hysterical applause." Only twenty years have passed since those items were news. The daily press now calmly tells of Costes and Bellonte winging from Paris to Mongolia in a single hop; of the *St. Louis Robin* circling tirelessly for seventeen days; of eight million miles being covered by the planes of the American air mail in a single year.

When Farman brought his biplane to America for an exhibition, a little more than twenty years ago, it had to be entered as a "theatrical effect." There was no heading on the duty list to cover it. Last year, our aircraft exports amounted to three and a half million dollars. In 1910, pilots were still classed as "madmen." They wore their caps backward. And they learned to fly in planes that shouldn't have flown.

Students largely trained themselves. They "cut grass" a few times. Then they hopped off—for better or for worse. An idea of how fledglings were instructed can be obtained by reading between the lines of this news item, dated April, 1910: "Mourmelon, France. Van Der Born, the old Belgian professional bicycle racer, has been a teacher at the Farman school here for some time. Recently he taught four pupils in a single week." A modern school takes six or eight weeks to teach a student to pilot a plane that almost flies itself. The marvel is that some of those early human birds are still alive.

Blanche Scott, one of the first girl flyers, is shown here in an early Curtiss plane, ready to take off. Note the shoulder yoke for balancing the wings.

One who flew under a lucky star was the Frenchman Louis Paulhan. In 1909, Paulhan was earning ten dollars a week as a factory mechanic. In 1910, he made $100,000 flying his Farman in cross-country races. He was small, with quick, birdlike movements. When excited he would rattle out words with the speed of a machine gun.

Exactly opposite in appearance and temperament was Hubert Latham, picturesque pilot of the wide-winged Antoinette monoplanes. He was a tall, morose man of few words. Doctors told him he was dying of consumption. He turned to aviation to get the biggest possible thrill out of his remaining years. Latham took chances no other flyer dared to take. He didn't care. He boasted of kicking fate in the shins. And he escaped uninjured in every crash. When death overtook him, it was far from a flying field. Just before the war, he was killed by a maddened water buffalo while on a hunting trip in the heart of Africa. He passed out, as he had wished, in a moment of adventure.

In those early days, every plane had its own system of control. The Antoinette had

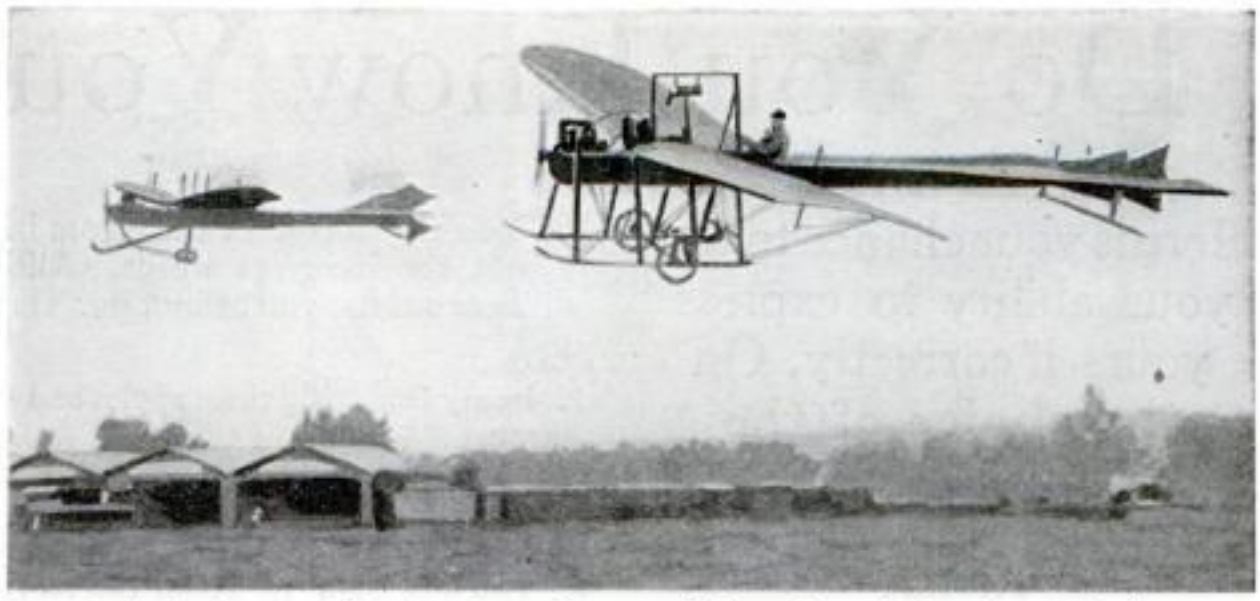
two vertical wheels, one on each side of the skifflike body. The right wheel operated the elevator. The left warped the wings. A foot bar governed the rudder. The Wright machine had two upright wooden levers. The right one warped the wings and steered to right or left. The other controlled the elevator. In my first plane, a Bleriot, I steered to the right or left with a foot bar on the cockpit floor and warped the wings and pointed the nose up or down with a small wheel, like that on a bobsled, located between my knees. My Farman was steered with a foot bar, and the elevator and ailerons were operated through a single lever at the right of the pilot's seat. In the Voisin, a wheel took the place of this lever.

Nowadays, two types of controls predominate. Both move the rudder with a foot bar. The "stick" control has a vertical bar located between the pilot's knees. It operates the elevator and the ailerons. The "Dep" control, used on large ships, has a wheel at the top of the stick. This wheel is turned to move the ailerons and is pulled back or pushed ahead to point the plane up or down.

Instead of "riding the ship through," leaning with it as it banks and twists through the sky, as pilots now do, the early airmen leaned away from the lower wing unconsciously, as passengers do on their first flight. This habit produced the Curtiss shoulder yoke and Santos-Dumont's curious shirt.

SANTOS-DUMONT, a tiny hundred-pound Brazilian, made the first heavier-than-air flight in Europe. In 1906, he hopped across a field on the outskirts of Paris in a cellular, box-kite biplane. Later, he built a butterflylike midget machine of bamboo and silk. Its wing spread was only sixteen feet. He balanced the tricky little craft by attaching the warping wires to a metal piece sewed to the back of his shirt. When a gust tipped the craft, he unconsciously leaned away from the lower wing and the action righted the machine. The Curtiss shoulder yoke was a similar arrangement. A metal bracket fitted around the flyer's shoulders and operated the ailerons. It was used on these planes until the war.

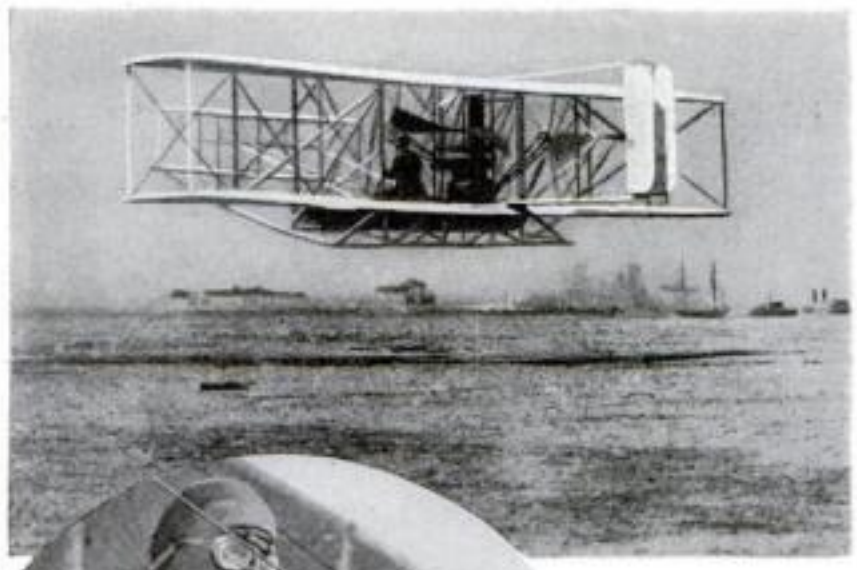
Many of the early machines, like the Farman and the Hanriot planes, had skidlike sleigh runners that extended from under the nose halfway back to the tail. Three times I have seen the wheels fall completely off such ships. Each time, the pilot cut the switch and sat down on the grass, sliding to a stop without damage.

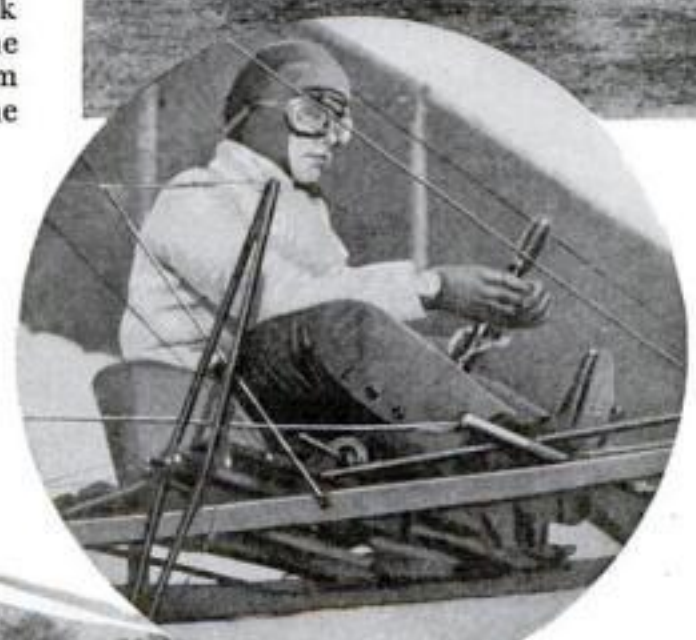


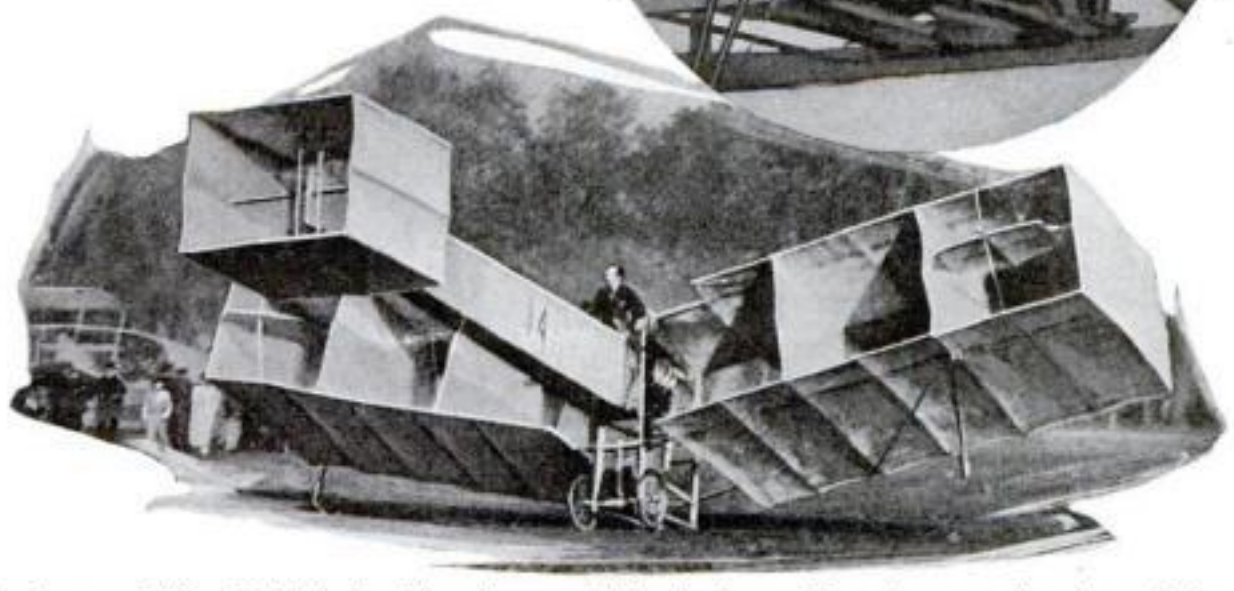
In 1910, the Antoinette and Hanriot, dragon-fly types of planes, shown in the photograph above, were filling the world with amazement while reckless aeronauts drove them in gruelling races across France.

Once the landing gear, skids and all, fell off a Farman I was flying. I had started off with a tank full of bad gas, a familiar occurrence in those days. The mechanics held the tail until the engine was racing. I raised my hand. They let go and the plane dashed off in a cloud of dust. The motor wasn't delivering full power. The ship reached bumpy ground at the end of the runway before it got up flying speed. Just as it lifted clear, the landing gear went to pieces and dropped off. Fortunately, the plane was a slow-moving bus and had lots of wing spread. When I cut the switch it pancaked into the weeds and I wasn't scratched.

A few weeks ago, I remembered those flimsy landing gears when I came down for the roughest landing I ever made. I was ferrying a big twin-motored ship to Philadelphia. It was zero weather. Over broken country in New Jersey, ice formed in one of the carburetors. The motor cut out. I swung into the wind in a one-gun turn and decided to land. The best field below was covered with dried weeds. I set the big ship down carefully with the nose high, as I couldn't see what lay under the weeds. Crash! Bumpedy-bump-bump! I thought the wings would shake off. I had landed crosswise to the frozen ridges of a potato patch. A landing like that would have made kindling of the old Farman, Voisin, and Bleriot ships I used to fly. Yet, when mechanics made a careful examination, they found that modern plane not even strained.







At the top: Wilbur Wright's first idea of an amphibian is shown. Note the canoe slung beneath the wings. In circle: A close-up of a Farman, showing the ladder that stuck out in front of the wings, on which the flyer sat. Below: Santos-Dumont's box-kite plane which he used in the first flight in Europe.

The first multi-motored plane I flew was a Farman "Goliath." It had a pair of 300-horsepower Clerget engines. Piloting it was a constant strain. If one motor cut out unexpectedly, the other would pull the ship into a spin unless the pilot acted on the jump. In a modern twin-engine craft, we make one-gun turns regularly, throttling down one engine and letting the other pull the plane around. And motors don't cut out now as they did a dozen years ago.

Then, more hours were spent on the ground tinkering with a motor than in the air flying with it. In pusher planes, the engines were placed just back of the pilot's seat. If he crashed or nosed over, the mass of steel crushed him or boiling water from the radiator scalded him. This position of the engine in early biplanes accounted for many fatalities. Because they (Continued on page 146)

Do You Know Your English?

Here is your chance to test your ability to express yourself correctly. On the choice of the right word may depend your future

A YOUNG man once wrote a letter of fifteen lines to a famous college president asking him to help him get a job. That letter is today hanging in a fine frame above this president's desk, and he has often said it was the finest piece of business English he had ever seen. The boy got the job.

Your own future may depend on your ability to express yourself in good, clear language. And language is something you *can learn;* it is not a gift from heaven. Recently experiments on language learning have been made among the prisoners in Sing Sing, many of them fifty to sixty years old with little or no schooling. Their rapid improvement in the use of language in both writing and speaking is amazing.

Here is a test by which you can tell your own language ability. It was devised by Dr. Richard D. Allen, assistant superintendent of the Providence, Rhode Island, schools. You are allowed just fifteen minutes to go through the test, which consists of thirty-six sentences, each containing alternatives in the choice of words, the wrong word to be crossed out in every instance. The correct answers will be found on page 144. Do not look at the answers until you have completed the test. Then you can score yourself by reference to the following:

Less than 12 failures, grade A
Between 13 and 17 failures, grade B
Between 18 and 23 failures, grade C
More than 23 failures, grade D

Dr. Allen finds that the average person who is still in school gets about the following number of sentences correct:

Age	No. Correct	Age	No. Correct
12	15	16	24
13	17	17	26
14	20	18	27
15	22	19 or over	31

Dr. Allen says that it often takes six months of schooling for the pupil to raise his score more than one or two sentences. The average eighth grade child gets about 17 correct; first year high school (ninth grade), 20; second year, 23; third year, 25; fourth year, 27; average college freshman, 29; average sophomore 32. He finds that the average American adult probably is not far from the eighth to ninth grade pupil in language usage. If you do better than this, you are probably above the average grown person in America, in grammar and language. You can greatly improve your score by reading and study.

You are to correct the errors in the following sentences by crossing out the incorrect words. Allow fifteen minutes. Do not guess. Leave those you cannot do. The correct answers appear on page 144.

1. Henry has **ate** / **eaten** three apples and has **gave** / **given** his brother one.
2. **Take** / **Bring** me the small picture first and then **bring** / **take** the large ones to Miss Blank.
3. It must **of** / **have** been very late when the boys **done** / **did** their work.
4. **To** / **Two** / **Too** men were **two** / **to** / **too** many **too** / **two** / **to** do the work.
5. Four pies were to be divided **between** / **among** six boys, and as a result, a fight began **among** / **between** two friends.
6. Did you see **they** / **them** and **us** / **we** in sailor suits?
7. Every pupil **is** / **are** to remember that this is **their** / **his** school.
8. The cold wind blew **fiercely** / **fierce** and made the children's cheeks look very **prettily** / **pretty.**
9. **Set** / **Sit** the light near your mother and **lie** / **lay** the book on the table.
10. Everybody **is** / **are** able to do **their** / **his** work by **themselves** / **himself.**
11. He **don't** / **doesn't** know who's to **chose** / **choose** the present.
12. You **was** / **were** never one to complain that the news we received **were** / **was** unfavorable.
13. **It's** / **Its** time the dog had **its** / **it's** bath.
14. The jury **have** / **has** returned **its** / **their** verdict.
15. Play the game **like** / **as** I do, and you shall not fail **as** / **like** John.
16. Did you ask if you **could** / **might** go to the library **and** / **to** get a book for school work?
17. The pair of scissors **is** / **are** not in **its** / **their** place.
18. The graduating class **have** / **has** just held **its** / **their** exercises.
19. As the men **lay** / **laid** in wait for the enemy, they saw three battleships **laying** / **lying** at anchor in the harbor.
20. He put his hands **in** / **into** his pockets and said, "I am the **tallest** / **taller** of the two."
21. John and his father **has** / **have** decided that twelve dollars **is** / **are** too much to pay.
22. Please **leave** / **let** the papers on my desk remain as they are, for I have **lain** / **laid** them in a certain order.
23. Mary **can** / **may** go with us, **may** / **can** she not?
24. Each of the boys **hope** / **hopes** to have **their** / **his** work accepted.
25. Did the teacher look very **sternly** / **stern** at the pupils when they did so **poor** / **poorly** in the examination?
26. I like to help those **who** / **whom** I love and **who** / **whom** I know love me.
27. Measles **numbers** / **number** many children among **their** / **its** victims.
28. I believe **he** / **him** and **she** / **her** to be honest.
29. Mary's money was stolen **off** / **from** her, which was different **than** / **from** losing it.
30. Neither John nor Frank **are** / **is** failing on the examinations because history and geography **is** / **are** easy for them.
31. **Most** / **Almost** any child can learn to swim **good** / **well** and almost all young people enjoy this sport.
32. Everyone was **their** / **there** except **she** / **her** and **I** / **me.**
33. I knew the visitors to be **they** / **them** as we invited all **whom** / **who** we thought would come.
34. As there is no doubt of **him** / **his** being invited, you **can** / **may** rely on **me** / **my** being there also.
35. Every book and paper **were** / **was** found in **their** / **its** place.
36. I **shall** / **will** see that John studies in the future, and I believe that he **shall** / **will** regret this later.

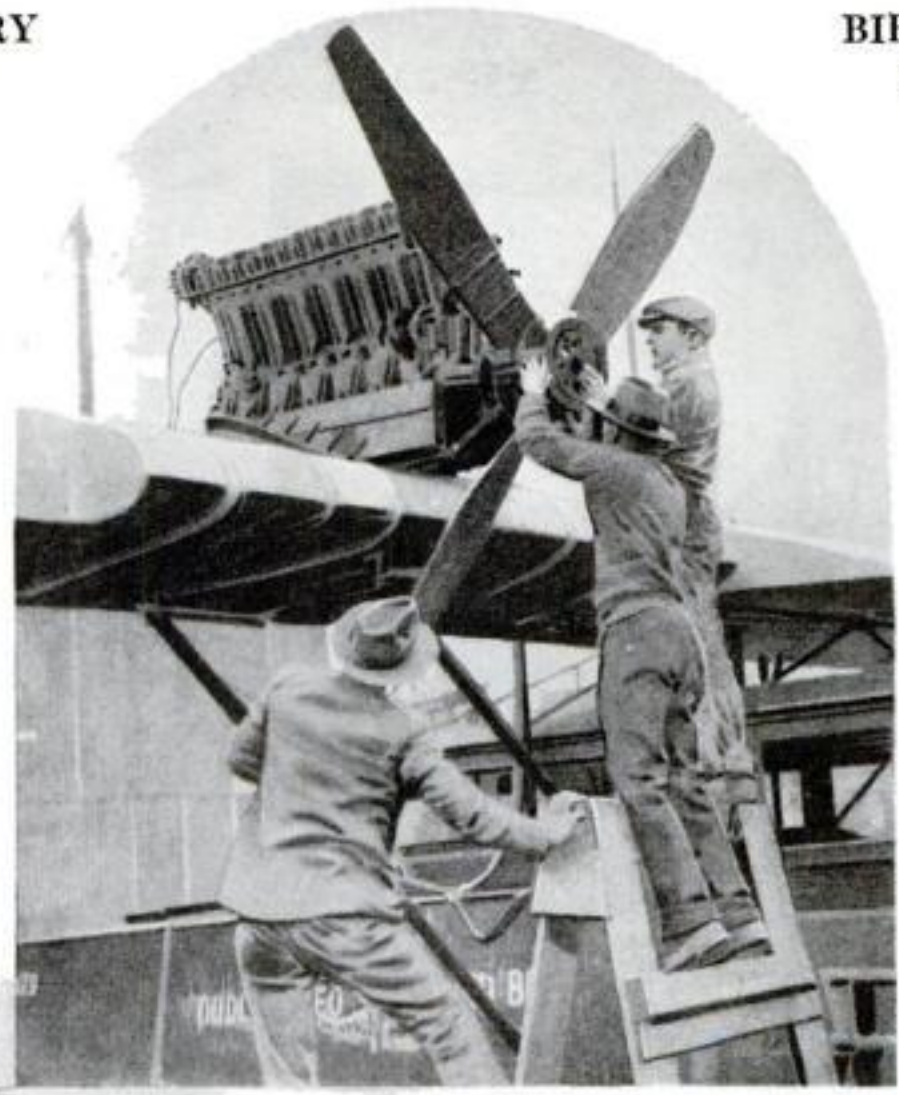
POPULAR SCIENCE SCRAPBOOK

News, pictures, and brief bits about unusual people, places, and things from all parts of the world are shown on this and the following pages

WINGED BOAT TO TRY TO CROSS OCEAN

A SPEED boat that may challenge aircraft in the offering of swift and safe ocean transportation has been in process of construction at Quincy, Mass. It is announced that the odd craft will attempt a transatlantic voyage when completed. Powerful struts, banked against each side of the hull, support a monoplane wing structure forty-eight feet wide. Two twelve-cylinder Liberty motors will propel the extraordinary ship at a speed of ninety miles an hour. The motors are to be placed along the top of the wing structure, as on a giant Dornier flying boat.

Forty feet long, with a wide hull allowing room for a spacious cabin, the boat will be able to carry thirty-two passengers. Its gasoline capacity is 1,100 gallons. It is said that the craft's movement will be like that of a flying fish, skimming from wave to wave. The aim of the new ocean speed boat is to achieve the highest speed possible without incurring needless danger. If the venture is a success, large ships of the same general design might be constructed for passenger service across the Atlantic. For the present, a speedy mail service might be started.



Mounting a four-blade propeller on one of the two Liberty motors carried in the wings of the craft.

Hull of new speed boat ready for airplane wings and motors.

LONGEST AIR MAIL TRIP

ARRIVAL in New York of the first air mail from Montevideo, Uruguay, South America, marked the completion of the longest air mail haul in aviation history. The 8,000-mile journey was from Montevideo across the lofty peaks of the Andes Mountains to Santiago, Chile, thence up the west coast of South America, and to New York via Panama, Canal Zone, and Miami, Florida.

NEW ITALIAN STEAMER MAY BEAT *BREMEN*

BEATING the record of the *Bremen*, fastest ocean liner afloat, is the aim of a steamer now being built at a shipyard in Genoa, Italy. The new vessel, with a 47,000-ton displacement, is expected to run from Cadiz, on the west coast of Spain, to New York, 3,151 nautical miles, in four and a half days. On her record trip last summer, the *Bremen* traveled 3,100 nautical miles in four days, seventeen hours, and forty-two minutes.

BIRDS FORETELL SPRING BETTER THAN MEN

AS THOUGH they possessed some mysterious knowledge of the exact date of spring's arrival in their northern home, migratory birds return to England from southern Europe and northern Africa just in time for the opening of the flowers. This curious fact has been observed by British workers in phenology, the science which each year records the first and last dates for such operations of Nature as the falling of leaves in autumn, the first appearance of buds on plants, the first opening of flowers, and the semiannual departure and return of birds of passage.

The time when these phenomena occur varies slightly from year to year, probably on account of differences in weather conditions. Observers at 467 English phenological stations, according to a report recently published by the Royal Meteorological Society, have noted that whether the spring be early or late, the return of the birds from their winter homes coincides almost exactly with the opening of the flowers. Phenologists believe that some hitherto undiscovered world-wide weather influence acts as the "signal" for both the beginning of plant growth and migratory bird travel.

ANCIENT SWAMP VILLAGE FOUND IN SWEDEN

ANCIENT ruins, perhaps dating back to the Stone Age, have been uncovered in the swamps of Dag in Ostergothland, a central province of Sweden, which have been the scene of interesting excavations since 1919. The diggings were supervised by Dr. Otto Froedin, Stockholm archeologist, and financed by the Swedish government. A primitive swamp village has been brought to light, built on the marshes and surrounded by a stockade like an early American Indian village. The choice of so undesirable a site for a large settlement seems strange, although, Dr. Froedin says, it was doubtless an ideal refuge from invasion.

Flat stones laid throughout a large part of the settlement give evidence of extensive road construction. The houses were floored with heavy logs. Fireplaces covered with ash, coal, and charred bones have been unearthed, as well as implements of stone and horn.

"NIGHTMARE" ANIMAL DOTES ON EGGS

This staring-eyed creature, the Madagascar aye-aye, is a distant cousin of the monkeys. The nut and egg show how it digs in with its finger to get its food.

WITH claws that call up childhood memories of witches' talons; a ghoulish, sharp-pointed face surmounted by naked ears; large, staring eyes; and an unkempt, bushy tail, the aye-aye of Madagascar, a cousin of the flying lemur, has well earned its appellation of a living nightmare. The creature is about the size of a large domestic cat.

In the wilds of Madagascar, where C. S. Webb captured the pair he recently gave to the London Zoological Gardens, the aye-aye has to fend for itself, and it finds the pursuit of food an excellent occupation. For this it is endowed with an extra long "middle finger" which it can thrust almost anywhere and move with lightning speed. Though the aye-aye likes to scoop honey from the combs of wild bees or gather grubs from bits of rotting timber, stolen eggs are its long suit. First it breaks a hole in the shell, then up and down goes the long claw, scooping out the meat of the egg and carrying it to the aye-aye's mouth, with such precision, it is said, that no morsel ever falls to the ground.

CHALK LINE FOR AUTOS

AUTOMOBILE wheels will run in grooves in a unique roadway under construction across Queensborough Bridge, in New York City. The grooves, about two inches deep, are a new experiment in keeping cars in line. The entire roadway is twenty-six feet wide and accommodates three lanes of traffic, with grooves in each. Low side walls, about twelve inches high, will also separate the traffic lanes. The new highway becomes possible with the removal of rapid transit rails from the upper deck of the bridge. The grooved roadway will be 10,300 feet long, one of New York's longest traffic arteries without grade crossings. The bridge with its approaches is over a mile long. More than 87,000 autos cross it in a day.

WOMEN STILL BEAT MEN IN TESTS OF EMOTION

THE ancient doctrine that woman is ruled by her passions and man by his reason seems to find fresh support in a new study of sex differences conducted at Stanford University in California by Prof. Lewis M. Terman and Dr. Catherine C. Miles. The evidence, based upon the statements of students themselves in answer to questions, indicated that women strike more intensely than men on the whole scale of emotions—anger, pity, fear, or disgust.

The most marked distinction between sexes was exhibited in the realm of disgust. Here only one man out of four showed anything like the aversion which the average woman showed in response to certain situations. Contrarily, the emotions of pity and fear were about equally manifested by both males and females.

However, the most satisfactory indication of the tests as a whole, the experimenters reported, was that older, more intelligent, and better educated individuals, irregardless of their sex, show a verging away from extreme emotional conditions of any sort.

$20,000,000,000 IN GOLD MINED IN 400 YEARS

A "BULLION CUBE" only 38.5 feet high, wide, and long would result if all the gold mined in the world since the days of Columbus were cast into one solid block. While this amount seems surprisingly small when depicted in this manner, four miles of street thirty feet wide could be paved with a one-inch thickness of the precious metal, it has been estimated.

The hypothetical block of gold would weigh about 65,000,000 pounds, or more than a billion ounces, and its value, at the current price of twenty dollars an ounce, would be somewhere in the neighborhood of twenty billion dollars.

According to the United States Bureau of Mines, more than half of the gold in existence today has been mined since 1900. This is due partly to the fact that the rich gold mines near the Klondike River in Yukon territory were discovered just before the turn of the century and have been developed since that time. Their yield in 1926 alone was estimated to be more than $879,000.

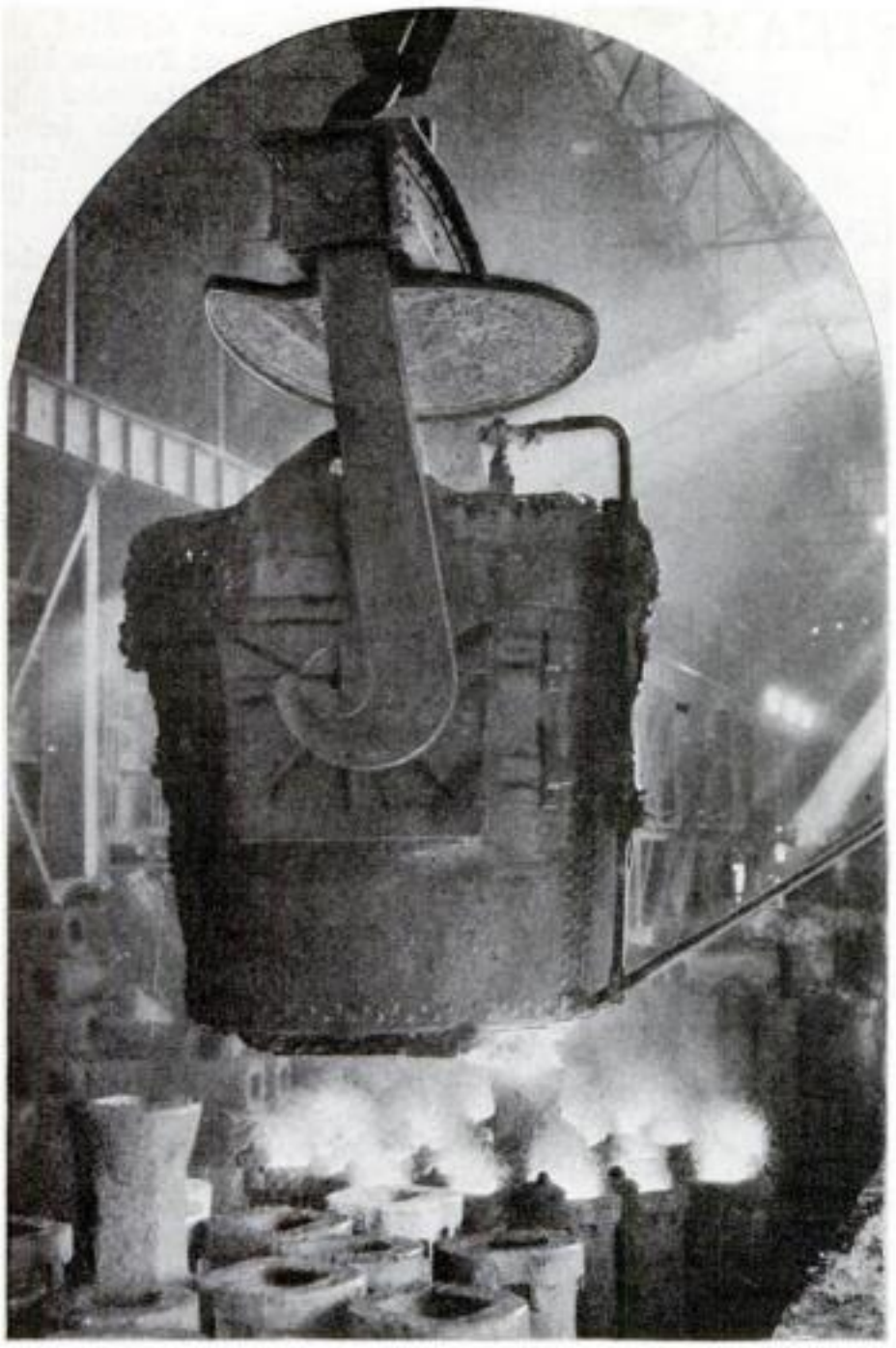
PLANT POSES AS SNAKE TO TRAP LIVE FOOD

NOT with the glitter of its eyes, for it has none, but by the glistening of its highly colored leaves, the darlingtonia, a unique carnivorous pitcher plant native to California, imitates the hooded cobra, which it somewhat resembles, in luring its unsuspecting victims to their doom inside its "stomach."

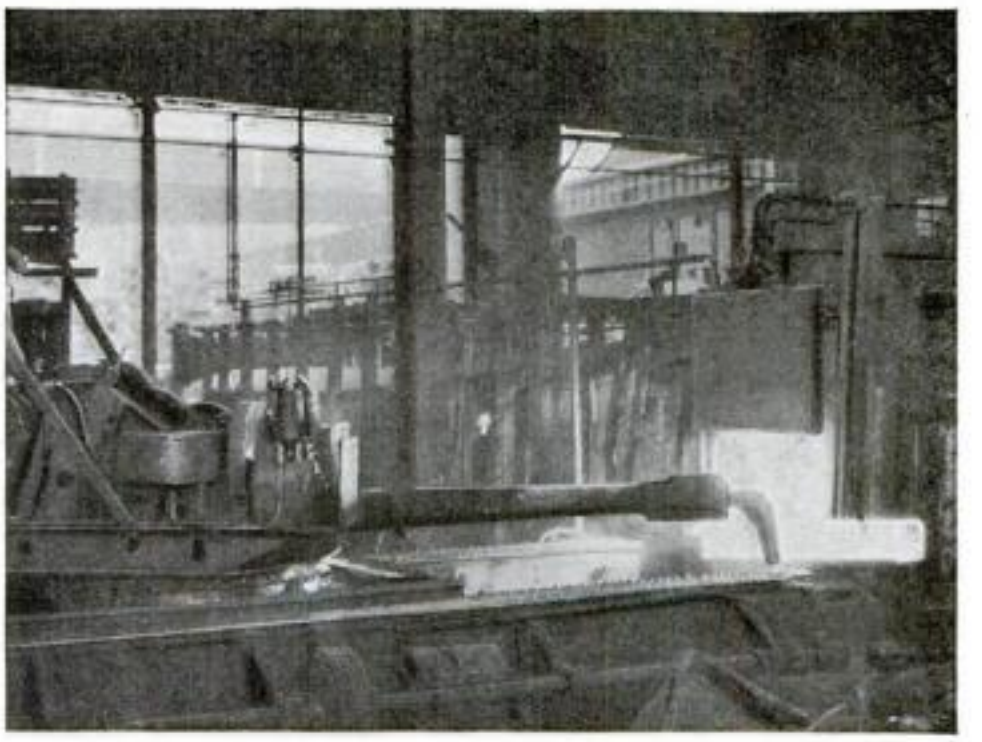
The plant, named after William Darlington, American botanist, consists of a cluster of hollow leaves, each shaped like a spiraled candlestick and rising straight up to a height of one or two feet. At the summit, where it is broadest, the leaf arches over to form a cobralike hood from which hangs a blade like the tail of a goldfish, protecting the mouth of the pitcher.

The insects that are attracted by the bright colors of the leaf find their way into this mouth and are guided to the bottom of the pitcher by downward-pointing hairs on its sides. Once down, there is no escape, for the hairs that formerly acted as guides have now turned jailers and bar the exit. In their unique prison the victims form a putrefying mess, and the products of their decomposition are said to be absorbed by the leaf of the plant as food.

Having no pride, the darlingtonia imitates the cobra in getting the insects which it eats.

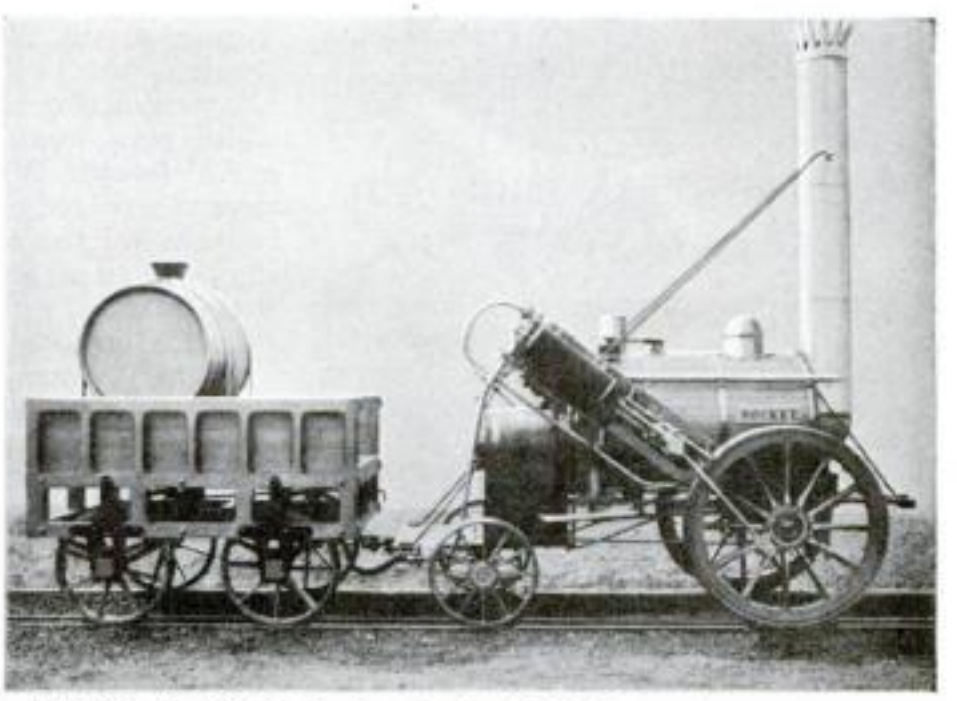


Danger Lurks in Liquid Steel. Enormous ladles of white-hot metal, which if released would spread in a devastating flood, are raised by great cranes and from them ingot molds are filled. At the right: Sixty-three tons of bubbling steel are surging into the ladle. This tapping of a furnace is one of the most thrilling moments in the whole process of the manufacture of steel.



This Arm Won't Burn. Machines that seem alive reach into the furnace, drag out the ingots of steel, and pass them to the rolling mill.

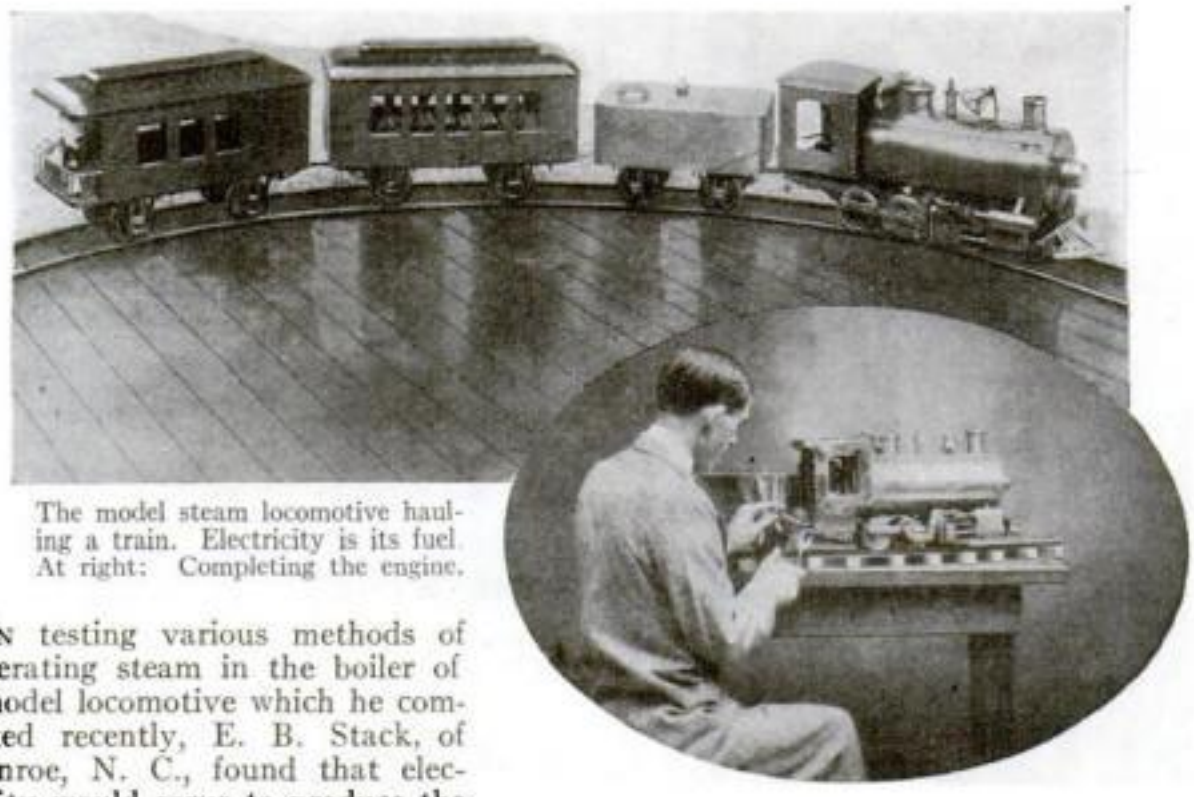
Accidentally Lifts Engine. A crane in the Pennsylvania yards, Chicago, grabbed a passing engine by mistake and wrecked it. The entire train was derailed and the engineer was injured. This gives a slight idea of the enormous power exerted by a big steel crane.



Not Much of a Rocket. It doesn't look like a real engine, does it? But it is the great-granddaddy of all locomotives. It is an exact reproduction of the *Rocket* built by Stephenson in 1829. It is now in the Ford Museum, Detroit. The original is in the Science Museum in London.

POPULAR SCIENCE SCRAPBOOK

ELECTRICITY RUNS MODEL STEAM LOCOMOTIVE



The model steam locomotive hauling a train. Electricity is its fuel. At right: Completing the engine.

IN testing various methods of generating steam in the boiler of a model locomotive which he completed recently, E. B. Stack, of Monroe, N. C., found that electricity would serve to produce the necessary heat. Instead of employing an alcohol burner, or burning coal under forced draft, two methods long and successfully used by other model makers, Stack fitted three 600-watt electric heating units directly in the boiler in contact with the water.

Cleanliness and freedom from fire risk are the principal advantages of this novel steam-generating system.

HIGHEST BRIDGE TO SPAN THE ROYAL GORGE

MORE than twice as high as any other bridge, the loftiest in the world is soon to be under construction across the Royal Gorge of the Arkansas River, near Canon City, Colo. If a stone were to be thrown from this structure it would travel more than a fifth of a mile before it struck the river, since its greatest height will be 1,053 feet. At present the world's highest bridge is the one at Lee's Ferry, in the Grand Canyon, 464 feet high.

WIRELESS PLAN PROPOSED NEARLY 60 YEARS AGO

RADIO, like many other inventions, had several fathers. It was not the practical triumph of Marconi alone that started it on its eagle flight, but the discovery of the electromagnetic law by Maxwell, the birth of Hertzian waves, and the dreams of obscure scientists grasping at straws of the ultimate truth. Among the latter was an idea embodied in a remarkable "wireless" bill proposed to Congress in 1872, twenty-five years before the first successful experiments of Marconi. This bill, now buried in the dusty files of the Congressional Record, proposed the formation of the Loomis Aerial Telegraph Company to exploit the theories of Dr. Mahlon Loomis, of Washington, D. C., whose principles bore a startling resemblance to those upon which modern radio is based.

"The theory," read the Loomis manuscript, "assumes that the earth itself, the atmosphere surrounding it, and the infinite depths of space encompassing this aerial world contain a succession of concentric circles or planes of electricity. Those nearest the earth are perpetually disturbed by oceanic currents . . . etc. Above these, pierced by the tops of loftiest mountains . . . are vast surrounding seas of undisturbed electricity, which may be affected by any interpenetrating galvanic force from beneath, causing electrical vibrations or waves to pass from that point within such electric plane around the world . . . "

Thus did one dreamer anticipate the great day of the loudspeaker.

WOMEN DRIVERS EXPECT TOO MUCH COURTESY?

AUTO driving and chivalry should have little in common, according to Dr. E. B. Turner, of the Medico-Legal Society of London, who blames the feminine sense of traditional courtesy for the accidents which most women incur on the streets and highways. When a woman driver arrives at a corner, she usually unconsciously looks for the same sort of treatment from a man who may be crossing there that she would expect at a dance or a concert. This is a fatal mistake, says Doctor Turner. Too many women drivers expect every one and everything to get out of their way. Otherwise, the doctor states, women drivers are among the best on the roads, making good use of their inherited quickness of perception and movement in avoiding difficulties.

FIND TOMB OF ANCIENT SCYTHIAN CHIEFTAIN

NEAR the Mongolian border of Siberia, Professor S. I. Rudenko, of Leningrad, has uncovered the massive log tomb of an ancient Scythian chieftain, believed buried more than twenty centuries. It reveals that these warlike horsemen of the steppes, known to have defeated the picked troops of the great Persian king, Darius, in 512 B. C., had attained a high state of culture in Central Asia before they migrated to the westward and came in contact with Greek and Persian civilizations.

The main room of the burial chamber had been looted, but the Russian scientist recovered bits of woven goods and a number of household objects. In another compartment were ten carcasses of the favorite horses of the chieftain, slain, evidently, to carry their master into the next world. They had been permanently preserved in the frozen soil.

Two of the mounts wore elaborate headmasks of skin and felt, ornamented with gold. Saddles and bridles, although of crude construction, were richly decorated with gold and carvings. The figures represented reindeer, carnivorous animals, birds, and human beings. The ten horses are being transported to Leningrad for examination by laboratory experts.

The tomb site is not far from the Gobi Desert, where the 1928 American Museum of Natural History Expedition, headed by Roy Chapman Andrews, uncovered remains of prehistoric "dune dwellers."

COLLECTING RARE WOODS HIS HOBBY AT 75

AT seventy-five a man is just young enough to take up a new hobby, judging from the experience of George F. Dyar, of Waltham, Mass., who has assembled what is said to be one of the most complete collections of woods and products from the trees of the world. In his home, Dyar claims to have more than 6,000 specimens, representing some 3,300 trees from all parts of the world, and including rare trees that are almost extinct.

The collector took up his hobby at the age of seventy-five when a long and almost fatal illness left him an invalid. Just as remarkable as the extent of the collection is the fact that Dyar's health has so improved because of his absorbing interest in his hobby that doctors who despaired of his life five years ago now see no reason why he should not reach 100.

George F. Dyar, 75-year-old collector of woods, with a few of his more than 6,000 specimens.

Aqua-Skiing Adds Thrills to Sea Sport

Here's a raging inferno formed of fifty gallons of burning gasoline, and through this sea of flame, a daring nine-year-old boy dashes on his swift flying aquaplanes.

Will he hit the target? Whirling along on an aquaplane, the archer tries for a bull's-eye—and sometimes he gets it. But hit or miss, it is fun to try and is a real test of archery.

Aqua-skis are as evil-minded as bronchos and in a cloud of foam each tries to follow in its own course, towed by a rushing boat. Great skill is needed to keep the feet traveling in the same direction and avoiding a spill.

Aquaplane jousting on the wide-open sea is sure to mean a sudden bath for somebody, but the thrill fans are eager to prove their skill and duck their enemy.

With a ski that is a small aquaplane on each foot, dare-devils face the sea and tempt a swift submergence in efforts to do stunts. Here the rider has just hurled himself into the air in the approved ski-jumping manner. His trouble comes when he hits the water. Then it's "ride her, boy," or take a deep dive.

Sometimes the aqua-ski jump fails to come off, though one of the skis does. In that event the water bug goes under the waves and comes up "all wet." But he claims it's great sport.

POPULAR SCIENCE SCRAPBOOK

TOWERS PEEK THROUGH SEA OF FOG

Gotham's skyscrapers piercing fog. In Grand Central zone at left the Chrysler Building rises highest; Times Square is in foreground; in the distance is the downtown financial section.

A CLEAR day, with brilliant sunshine gilding dome and spire, is not always essential to bring out the high points of a great city's skyline. A day of fog and mist may sometimes do the trick even better. This was demonstrated recently by an aerial photographer who took this random shot of New York City, blanketed in thick fog. The unusual success of his picture, revealing the tremendous mass effects of Manhattan's labyrinth of towering buildings, shows how a snapshot may frequently produce striking results unlooked for in this type of photo.

ROMAN GODS FOUND IN OLD GERMAN WALL

NEW and unexpected treasure turned up by the spades of archeologists is the discovery of a ruined foundation wall made entirely of sculptured Roman stones near the Rhine country town of Alzey in Germany. Dr. Friedrich Behn, curator of monuments at Mainz, tells the story of the remarkable wall in a recent edition of a German scientific periodical. The explorers, on the track of the remains of an early church, came upon the crumbled ruins of a building far older than the one they sought, a curious structure about sixteen yards square, of which little remained but the foundations themselves. These were composed largely of the sculptured fragments of ancient pagan shrines and temples, including nine altars, twenty-five sections of pillars, four inscribed stones, six broken statues and reliefs, and six blocks with images of gods on all four sides. The presence of so much valuable stonework thrown into the bulwarks of a building in such haphazard fashion suggests that the builders were hostile to the old Roman gods, and demonstrated their contempt for them in this way.

GOVERNMENT COMES TO ANTELOPE'S RESCUE

THE antelope, diminishing rapidly in the West up to a few years ago, is now coming back. This graceful and fleet-footed animal once roamed the American plains in herds numbering a million, but a census of a decade or so ago disclosed less than 5,000 of them left. Pioneers had tracked them down, but with the advent of the automobile, more relentless hunters had pursued them; and in late years even airplanes had joined the search to kill. But the Government took up the little prong-horned animal's defense. Efforts were made to "plant" the antelope in likely ranges whence they had vanished, as on the floor of the Grand Canyon, and hay was provided for them when the snow lay deep. The results were encouraging. In 1927 there were about 7,000 accounted for; in 1928 the estimate was 7,700; in 1929 it was 8,500.

Other familiar North American animals in need of rescue were included in the revival campaign. The bison, the elk of Yellowstone, the great moose—all are on the up grade of reproduction. Today probably ten times as many deer range the Northeast as a quarter of a century ago. To restore the old abundance of wild life requires public support of the Government's efforts.

ONLY FOUR ANIMALS OUTLIVE MAN

GENERALLY believed to reach the fabulous age of 500 years, the whale never lives beyond forty. The longest authentic record for the elephant, supposed to live to the century mark, is seventy years.

The fact that these great animals do not outlive man has been established by Professor A. D. Peacock, of University College, Dundee, Scotland, who recently completed an exhaustive study of the subject. He found that there are only four creatures whose ages regularly exceed those of human beings. They are the giant tortoise, which reaches the ripe old age of 150 years and may live to 200; the German carp, whose life span is also a century and a half; the white-headed vulture, one specimen of which holds the 118-year record; and the eagle, which has known to pass its 104th birthday. Other centenarians among the birds are the parrot, the crow, the raven, and the eider duck of the Arctic regions.

Here are the maximum ages attained by some domestic animals and fowl, as well as wild animals, according to Professor Peacock's tabulation:

Dog, thirty-five years; horse, forty; cow, twenty-five; cat, forty; hen, thirty; goose, fifty-seven; lion and tiger, twenty-five.

Salmon and sharks may live to be 100, eels to be sixty; one toad is known to have reached the age of thirty-six, and an alligator that of forty. The shortest lives are among the insects. The winged male of a species called Stylops may live only from one to three hours. The house fly lives about thirty-four days; on the other hand, ant queens have reached the age of thirteen years. A fire beetle holds the insect record, having been found alive in a piece of wood it must have entered thirty-seven years before.

RUSSIAN EX-GENERAL NOW MENDS RADIOS

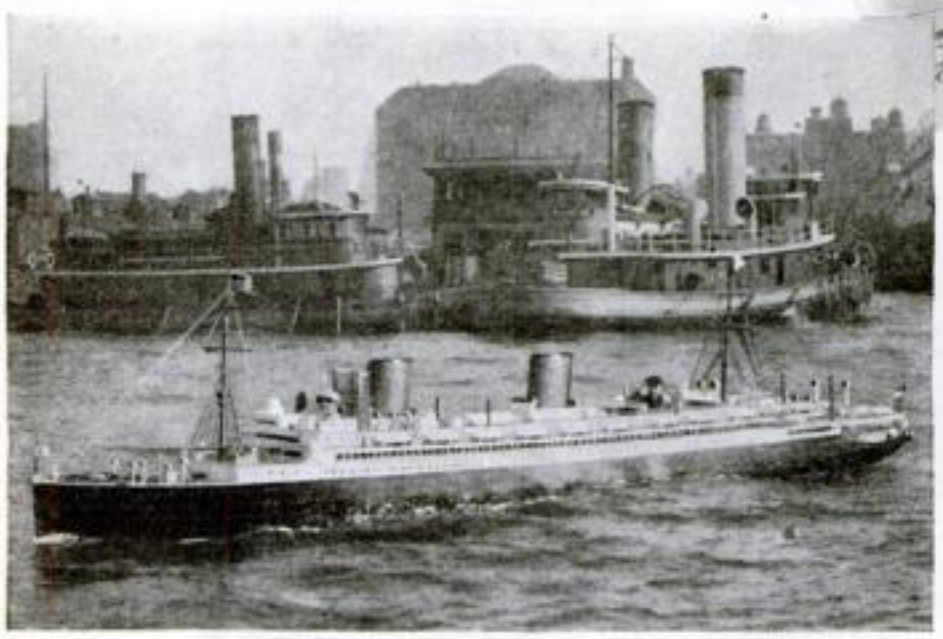
MAKING balky radio sets behave is now the peaceful occupation of a former major general in the Imperial Russian Cavalry, George C. Oustimovich. The excitement and clamor of leading the Czar's horsemen in the days before the war have been supplanted by the quiet of a small radio repair shop in New York City.

When Oustimovich arrived in America, after the Russian Revolution, he put his knowledge of radio to practical use and opened up a little shop where, instead of a flashing saber, he now wields harmless pliers and screw driver, adjusting and testing the rebellious instruments brought to him for repair.

George C. Oustimovich, once major general in Russian Cavalry, repairing a radio set in his shop.

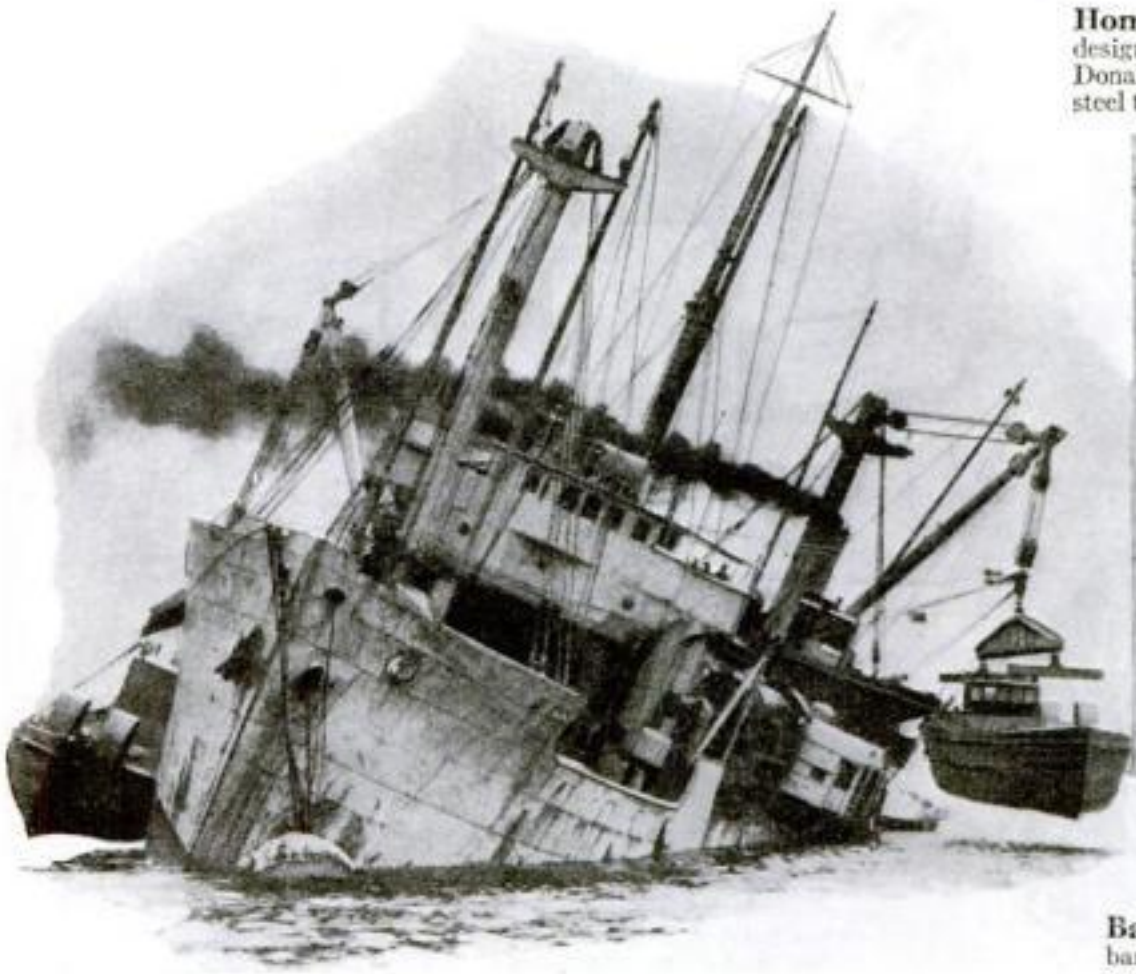
An Arctic Scene in New York. This wind-swept view of Bering Sea with Arctic birds disporting themselves looks exactly like the real thing, but actually it's no farther north than the American Museum of Natural History in New York.

Driving Taught in Office. Chief Safety Instructor L. B. Gordon, of the Pacific Telephone and Telegraph Company, is displaying a board, equipped with map of San Francisco and showing traffic problems, which he uses in teaching the Company's hundreds of chauffeurs how to drive.



Ship Model Carries Crew. This remarkable twenty-six-foot Diesel-driven model of the North German Lloyd Liner *Columbus* recently cruised up the Hudson River at New York carrying a complete crew of two.

Homemade and Simple. This little 480-pound airplane, designed by Earl Clark, right, and built by him and his brother, Donald, left, of Buffalo, N. Y., has only two wooden struts, five steel tubes, and four brace wires. It carries a 28-horsepower engine.



Building Their Own Abbey. Monks of Devonshire, England, started work on a new abbey twenty-three years ago. They have done all of the work.

Barge Is a Counterweight. Loading steel barges on the River Tyne gave this ship a dangerous list. So the captain swung a barge on the opposite side to keep his boat from foundering.

POPULAR SCIENCE SCRAPBOOK

New Household Devices

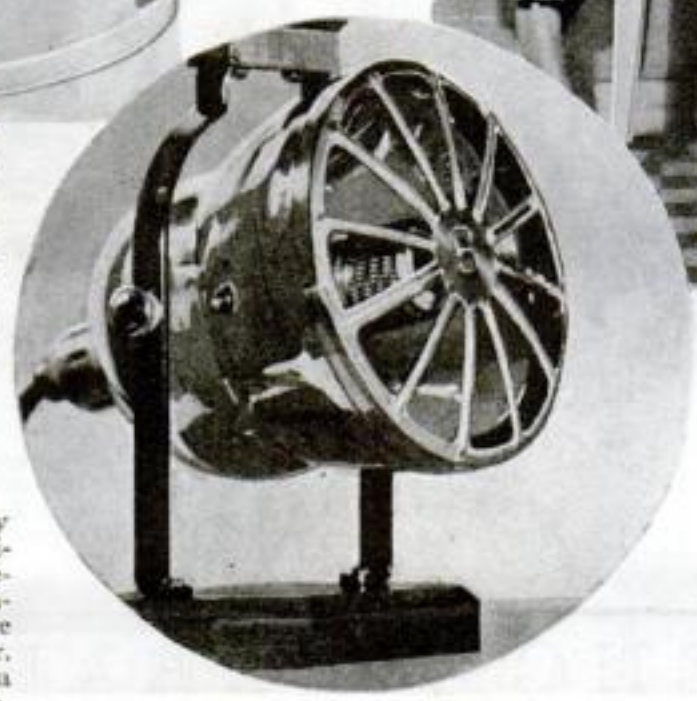
Appliances, Machines, and Utensils Invented to Save Labor and Add to the Comfort of the Home

Sweeping the kitchen is simplified by a sanitary dust chute of steel built into the baseboard. A swinging door opens at the touch of a foot lever, and sweepings go down the chute to the basement.

The curtain "hold-back" at the right consists of a curved metal arm pivoted on a support fastened to the window frame. It draws back the curtain to admit more light.

A new type of electric exerciser, pictured above, requires no bulky stand nor cabinet. It may be clamped quickly to a door or even a window sill. When not in use it can be tucked in a drawer, or placed in a bag for traveling.

This electric "floor heater" does not concentrate its heat in a beam, but radiates it in all directions. Its streamlined base facilitates the movement of rising air currents that warm the room.



Compact and attractively cased, the two-purpose radiant heater at the right is designed especially for a woman's dressing table, where it serves as a hair dryer. At other times it warms a cold spot in a chilly room.

Built up in sections, like a sectional bookcase, a new electric range may be made as simple or elaborate as desired. By adding parts to the basic unit consisting of base and oven, fifty combinations are possible. The range can be adapted to right- or left-handed users.

Above are two views of convenient breakfast table tongs for handling a hot boiled egg without danger of burning the fingers and without the use of a napkin. When the handles are squeezed, the curved jaws of the device grip the egg firmly while exposing one half of the shell for slicing with the knife.

The handy wall brush at the right has near its head two hooks, one of which will take down a picture and replace it; the other pulls down window shades that have soared skyward. Triangular brush makes it easy to clean corners.

Here is an electric clothes washer without a motor. It operates magnetically, much like a doorbell, to agitate the water in the vessel and force it through the wash. In the cover is an "impeller" which vibrates 120 times a minute, having the effect of agitating the water and suds.

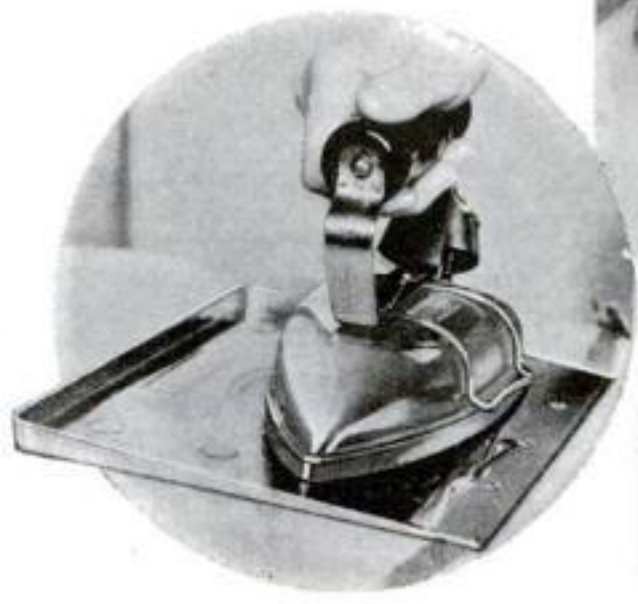
Dishes are less likely to be chipped when washed in this papier-mâché dish pan. The composition is not hard enough to damage a plate that drops on it, yet is firm enough to make a serviceable basin.

A combination clothes washer and ironer. After clothes have been washed in the machine at the left, the twenty-six-inch ironer roll at the right irons them neatly. It does not interfere with the washing operation and may be left attached to the washing apparatus permanently.

A new electric bottle warmer heats the baby's milk to just the right temperature, then shuts off automatically. At the same time a signal light flashes to indicate that the milk is ready.

No lifting is required to dump this outdoor incinerator. Mounted on a stand, a turn of a handle swings it and drops its ashes and residue into a pail for disposal. While the contents are burning, the handle shifts them about, thereby aiding complete combustion.

The diminutive household jack shown at the right is handy for such purposes as lifting a heavy stove to replace a leg, or raising one corner of a piece of furniture. It is sturdy, and exerts a push of 500 pounds.



One side of the iron rest at the left is flush with the ironing board so that the iron need not be lifted. The other three sides are raised to keep the iron from falling off. Under the base is a layer of asbestos to prevent scorching the board or cover.

Popular Science
MONTHLY

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What Is the Lesson of Air Crashes?

WITHIN the last few months a succession of air tragedies has shocked America. Worst of all, they have occurred on established, scheduled air lines. The victims have been passengers who rightfully expected safe transportation.

It is easy to say, and true, that such accidents are inexcusable. But the causes should be determined, so that no more will occur. Almost every alibi has been offered—weather, possible mechanical failure, Acts of God. Nobody, though, has offered the obvious suggestion that the pilots may have been temperamentally unqualified to fly passenger planes.

A pilot must have had a certain number of flying hours, or he would not be licensed to carry passengers. But the mere possession of a license does not mean everything. Suppose a former air mail pilot becomes a transport pilot. The nervy young pilots who fly the mail may not be actually encouraged to risk their lives in bad flying weather, but it is no secret that they take a certain pride in "getting through." That pride has no place in passenger transport by air—where the decision as to whether the plane shall fly is left with the pilot. It is an air mail pilot's privilege to risk his own life, if he wishes; no transport pilot has the right to risk his passengers' lives.

At present most transport companies require that their pilots be young men. It may be that passenger aviation calls for older pilots, aviators of balanced judgment. Certainly repeated emphasis on safety should be made by the operators of passenger air lines and responsibility for taking the plane in the air should not be invested in the pilot alone. Pilots should be forbidden to fly in bad weather even if they believe they can get through. This is the ordinary practice in Europe, where passenger aviation was well established long before it was even tried in the United States.

Morons at the Wheel

THAT morons can be automobile drivers is no surprise to motorists. Not only will they readily agree with this statement of Dr. Knight Dunlap, in charge of the National Research Council's tests of drivers, but they will go farther and assert, from their own experience, that many of the drivers they have met on the road are morons—or worse.

But Dr. Dunlap's assertion that mental speed and high intelligence do not necessarily make a good motorist is of real interest. He insists that the honor college student and the moron can both be trained to be good drivers, who perform automatically and efficiently all the motions necessary in the operation of a motor car. And there is no substitute, he says, for the kind of training he suggests, which is nothing more nor less than common sense practice—and plenty of it—in handling clutch, brake, and gears. Dr. Dunlap approves license tests because they compel a driver to learn at least something.

What this investigator has discovered about accident prevention through education of the man at the wheel is detailed on another page of this issue. It is based in part upon a series of unique psychological tests—the first of their kind ever attempted—designed to find out what an auto driver thinks about.

Safe Gliding to Be Safer

THE United States Department of Commerce announces that gliders, like airplanes, are to be licensed by the Government. The machines must meet definite tests of airworthiness, and in towing-gliders an approved device for releasing the cable will be required. Already, 110 applications have been received.

This decision is a wise one. When properly constructed gliders are flown under normal conditions, the sport is as safe as bicycling. The chief danger in gliding at present is the homemade, makeshift machine that is structurally unsound. The licensing of gliders by the Government, by weeding out the unfit machines, will give added emphasis to the safety of gliding. It will encourage many to join in this stirring new sport of the air.

More of the Same Still Needed

NEWS that the House of Representatives has acted to provide the United States Patent Office with increased funds will be little comfort to the inventor still waiting, after two or three years, for his patent. But it should tend to speed up the patent machinery, which of late has creaked dismally.

The bill just passed by the House appropriates $3,474,930 for an increased patent staff and for higher salaries. This will provide the Patent Office with 110 more examiners and thirty additional clerks. An extra Assistant Commissioner and another Examiner-in-Chief, to help the Patent Office's Board of Appeals catch up with its work, also will be available.

This is a move in the right direction, as is the Personnel Classification Board's recent action in boosting the grade and salary of Principal Examiners. The benefits are twofold. One will be to reduce materially the disgracefully long time often required to get a patent. Another will be to make a patent more valuable, by assuring a higher grade of examiner to pass on the application. It has been common knowledge that a United States patent was less authoritative, for instance, than one granted in Germany. It was merely *prima facie* evidence, when issued by the United States, that the idea was patentable, and was no guarantee that it had never been patented.

They Are Saying—

"THE crass, selfish, blatant advertising fostered over the air by avaricious stations will in time kill public acceptance of broadcasting."—Dr. Lee De Forest, inventor of the audion; "father of radio."

"The antiquity of man is as great on the American continent as in any other terrestrial locality."—P. E. Cox, archeologist, State of Tennessee.

"Man already possesses ten senses, and in a few million years his descendants will have developed a lot more."—Dr. Karl G. Miller, professor of psychology, University of Pennsylvania.

"Excess noise is a contributing cause in street accidents, and tends to keep city dwellers constantly keyed up to the fighting pitch."—Dr. Shirley W. Wynne, health commissioner, New York City.

"The average man of today cannot get into a Crusader's suit of armor; he is bigger and taller than his medieval ancestor and his shoulders are too broad."—Dr. Joyce Partridge, London surgeon.

"In fifty years, there will be an automobile which will use a rotary engine, go sidewise as well as forward and backward, and be gearless."—Roger W. Babson, statistician.

"A general knowledge of fundamental physical science is often more valuable than special training and routine."—Professor Albert Einstein.

How Many Tubes Do You Need?

Number Is Only One Factor in Performance of Set– Design of Circuit is Important

By ALFRED P. LANE

COUNTING the number of tubes in a radio receiver is no way to judge its quality. It is, in fact, no more accurate than to judge an automobile by the number of cylinders in the engine. There is, for example, an eight-cylinder car on the market that develops 265 horsepower. Another has a sixteen-cylinder engine that develops 150 horsepower. In a radio set the number of tubes used is important, but it is not the only deciding factor.

Preparing radio receivers for test in Popular Science Institute radio laboratory. The set at the left of the picture has fourteen tubes, the other has eight.

About the only thing that the number of tubes in a set actually determines is the upkeep cost. The more tubes used the more it is going to cost for electric current to run the set, and the larger will be the bill for tube replacement.

In the early days of battery operated radio sets there were but two types of vacuum tubes available—the so-called "hard" or amplifier tubes used for radio or audio amplification and the so-called "soft" tubes that were, because of their lower vacuum, particularly suited for detection.

As the desirable qualities of a vacuum tube became more clearly defined, new tubes were developed with specialized characteristics. Today there are special tubes for radio-frequency amplification, as for example the screen grid tube.

The type 227 A.C. heater tube comes nearest to being the present-day all-purpose tube, and there are several types of power tubes particularly suited only for use in the last audio amplifier stage.

Before the radio engineer designs a receiver, he must decide what characteristics the proposed set is to have. Then he strives to obtain these with the minimum number of tubes.

Experience has shown that, under modern broadcasting conditions, three or four tuned stages are necessary to give adequate selectivity. The sensitiveness of the circuit must be such that satisfactory reception can be obtained from short antennas in unfavorable localities.

AFTER the signal is amplified at radio frequency and at the same time sorted out from signals from other stations, it must be rectified or detected and then amplified at audio frequency.

In the radio-frequency stages the amplification obtainable from three screen grid tubes represents the practical limit. That amount of amplification will always get down to static level, and any additional radio-frequency amplification would, therefore, be useless. Of course, it would be possible to design a radio set with four, five, or even six screen grid tubes, but it wouldn't be any more useful in bringing in distant stations than a set using three. Of course, the mere fact that a set has three screen grid tubes in the radio-frequency stages does not guarantee that it will give maximum performance, though it does point to that possibility. In the detector stage, only one tube is necessary, and in the audio stages only three can be used to any practical advantage—one as the first audio stage and two of the power type in the last or push-pull stage.

THE possible volume on local stations with satisfactory tone quality is indicated to some degree by the tubes used in the audio amplifier end of the set. In two well-designed receivers, the one using only a single 171A tube obviously cannot give the volume, with good tone quality, obtainable from a set with two type 245 tubes in a push-pull circuit.

Although push-pull amplification, if properly used, will give the finest tone quality, poor audio transformers in a push-pull circuit will spoil the tone quality just as they will in any other type of audio amplifier circuit.

So much for the tubes that actually handle the broadcast signals. In electric sets made today other tubes also are needed; at least one, sometimes two, and, in special cases, even three. If the set is of medium power—that is, one using up to two 245 tubes in the last audio stage—a single type 280 rectifier tube will take care of rectifying the necessary current for the B circuits of the set. In elaborate receivers, two type 281 tubes are used in the rectifier circuit, and in some sets a third tube is used which functions as a ballast tube to compensate for changes in the electric light current voltage at various times of the day.

To sum up, the finest results can be had from a circuit using not more than three screen grid tubes, one detector tube, one first audio amplifier tube, and two power tubes. Seven tubes in the radio circuit and one rectifier tube gives a total of eight tubes as the maximum number that can effectively be used. If still greater volume is desired without increase in selectivity or distance getting ability, one more rectifying tube may be added.

It is easy to see, therefore, that a set advertised as having ten, twelve, or fourteen tubes is not likely to give results in proportion to the cost of operating it.

Furthermore, the mere fact that a set has the maximum desirable number of tubes does not mean that it is going to give maximum results. The entire circuit must be carefully worked out in order to obtain full results from the tubes. That is why an eight-tube set sometimes does not equal other sets which use fewer tubes but are better engineered.

It must be clearly understood that tone quality and volume on local stations depend entirely on the tubes in the audio amplifier end of the circuit, and not at all on the number or arrangement of the screen grid tubes in the radio-frequency circuit. If the purchaser is not interested in distance and only requires a moderate degree of selectivity a simpler circuit will satisfy his requirements.

TWO, or at most three, type 227 tubes in the radio-frequency circuit instead of the more expensive screen grid tubes will give him the necessary degree of selectivity and more than ample sensitiveness. If less volume, but equally good tone quality, is required, together with maximum sensitiveness and selectivity, two or three screen grid tubes are required in the radio-frequency stages, but the audio stages may consist of only two tubes, one 227 in the first stage and a single 171A tube, or preferably two 171A tubes, in the second stage.

HELPFUL KINKS FOR THE RADIO FAN

Novel Condenser Capacity Test

Drop Cord, Socket, and Electric Light Bulbs Reveal Condenser Secrets—Hooking Headphones to A.C. Set

MEASURING the capacity of a fixed condenser is quite a problem to most radio fans. Condensers sold over the counter are, of course, marked with the capacity in microfarads. It is, therefore, easy enough to purchase a condenser of any desired capacity.

The problem is to determine the capacity of condensers after the label has become defaced or detached, or to measure the capacity of a condenser in a factory built set which in all probability is not marked.

A fixed condenser of any capacity placed in a circuit will prevent the flow of direct current, but alternating current will flow through the condenser in quantity depending on the voltage, the frequency of alternation, and the capacity of the condenser. These facts provide a simple way to test condensers where a rough approximation of the condenser capacity is all that is required.

In any radio circuit, unless a condenser is used in a tuned portion of the circuit, the capacity can be varied within wide limits. This is true also of the power or filter circuits which supply the B current.

That is why a rough approximation of condenser capacity will do.

A method of testing condenser capacity is illustrated. Of course, a source of alternating current is necessary. The 110-volt A.C. current from the electric light line is suitable.

Connect an electric light socket to one end of a twisted drop cord. Attach a plug to the other end. Then cut one of the two wires which, twisted together, form the cord. Unwind each of the two ends for a few inches and solder each end of the cut cord to a separate piece of stiff wire, such as bus wire. Then tape each joint thoroughly, allowing a quarter of an inch of the bare wire to project from the taping. Place an electric light bulb in the socket. Push the plug into a wall socket and if the bulb lights up when the two test points are touched together the test circuit is ready for use.

Electric light bulbs of ten, fifteen, twenty-five and fifty watts should be obtained. The capacity of a condenser in microfarads is determined by connecting the test points to the terminals of the condenser and estimating the flow of current by the effect on the light bulb in the socket. If, for example, the condenser to be tested has a capacity of one half microfarad, the ten-watt bulb will glow red and the fifteen-watt bulb will produce a glow that is barely perceptible. If the condenser has a capacity of one microfarad, a fifteen-watt bulb will glow red and the twenty-five-watt bulb will be very dim. With a two-microfarad condenser the twenty-five-watt bulb will glow a dull red and a three-microfarad condenser will make the twenty-five-watt bulb bright red. The fifty-watt bulb will be very dim with a four-microfarad condenser, but will be bright red with a six-microfarad condenser.

Working out the simple condenser capacity test method in the radio laboratory of the Popular Science Institute.

If on testing a condenser of any capacity the bulb appears just as bright as it does when the test points are connected directly together, it is an indication that the condenser is short-circuited or blown-out.

A B C's of Radio

WHILE distortion obviously results in poor tone quality from the loudspeaker, poor tone quality is not necessarily distortion. As commonly used the terms "distortion" and "poor tone quality" do not have the same meaning. Poor tone quality is the term used to label the output of a radio receiver so poorly designed or built of such poor parts that all reception, whether at high or low volume, does not even approximate true reproduction. Distortion, on the other hand, is generally considered to be the inaccurate reproduction resulting from overloading the tubes or operating them under improper conditions.

Every radio receiver has a distortion point. If the volume control is pushed too far on local stations the distortion point will be reached, no matter what tubes are used.

Headphones Aid the Partly Deafened

IF ONE member of the family is hard of hearing the radio receiver usually has to be turned on so loud as to be objectionable to the rest of the family. The solution is to add a pair of headphones. If it is a modern electric set the chances are it is fitted with a dynamic speaker, and, in such a set it is common practice to use a special output transformer of the step-down type which feeds directly into the voice coil of the dynamic speaker. It is not possible with such an arrangement to connect the headphones in parallel with the speaker cord. The simplest solution is to connect the headphones across the input terminals of the output transformer inside the set and connect in each wire a two-microfarad condenser having a voltage rating not less than 300.

If the receiver uses a push-pull circuit in the last stage, the leads from the headphones should be connected to the outer terminals of the input winding of the last transformer. In many sets it is impossible to get at these connections without taking the chassis out of the case and partly disassembling it. In such cases it is possible to make external connections to accomplish the same results. Locate the plate prong of the power tube, or in the case of a push-pull circuit of the two power tubes, and connect the headphones across between these two prongs by way of the condensers as above mentioned. Be sure to include in series with the headphones a variable resistance that can be adjusted to at least half a million ohms.

The set's volume control will give the proper volume from the loudspeaker, and the person using the headphones can adjust the volume from the headphones by the separate variable resistance.

The fixed condensers are needed to insulate the headphones from the high voltage applied to the plate or plates of the power tubes, thus protecting against dangerous shocks.

Shifting Antenna to Avoid Static

No Known Way to Eliminate Trouble, but Altering the Aerial May Reduce Disturbance in Proportion to Strength of Incoming Wave

By JOHN CARR

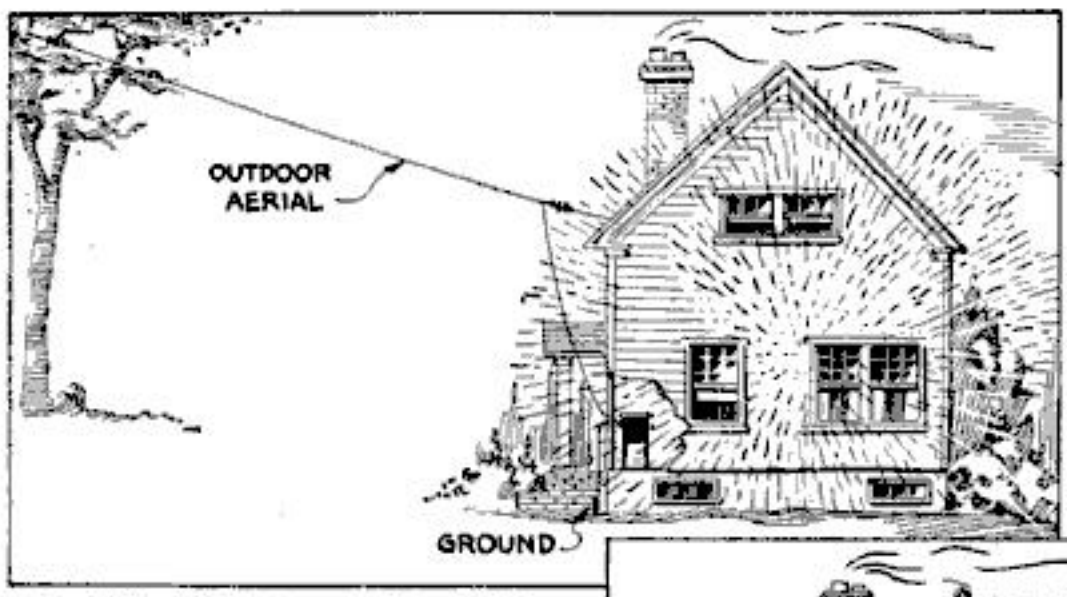


Fig. 1. How a long antenna may be outside the zone of man-made static shown by shading.

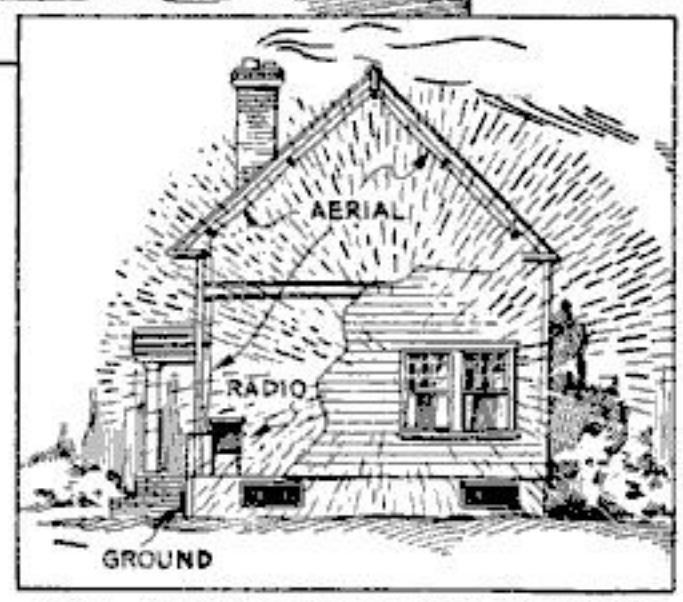


Fig. 2. An indoor antenna under such conditions may be entirely within the man-made static zone.

THE radio antenna is an indispensable link in the chain of broadcast reception. It brings the radio-frequency impulses sent out by the broadcast transmitter into the radio receiver. No set can work without one any more than a person can see without eyes. Even sets sold as "antennaless" really use an antenna. It may be only a few inches of wire inside the cabinet, or perhaps the electric light wiring is utilized, but some substitute for an ordinary antenna is there, nevertheless.

Furthermore, the quality of the reception depends largely on the skill with which the physical dimensions of the antenna are fitted to the radio peculiarities of the particular location where the set is to be used.

The variation in the characteristics of different radio receivers together with the wide differences in the radio characteristics of different locations make it impossible to lay down hard and fast rules as to what is or is not the best radio antenna. A combination that is exactly right for one location with a certain set may be entirely wrong in another location on the same set or on a different set. Moreover, the requirements of radio set owners differ within wide limits, and to make matters still worse, there are many widely circulated but erroneous beliefs connected with antennas.

The desired result, of course, is to bring in the broadcast signal with the minimum amount of interference from natural and man-made static.

THE current belief that the shorter the antenna the less trouble with static interference of any kind is wrong more often than not. Under certain conditions, reducing the length of the antenna may increase the amount of interference from man-made static.

Static, whether of the natural variety produced by atmospheric conditions or of the man-made kind caused by the operation of electrical machinery, enters the radio set by way of the antenna, just as does the wave from a broadcast station. There is no known way to sort out and eliminate static of either description. All that can be done is to alter the antenna so as to reduce the amount of static it picks up in proportion to the strength of the incoming broadcast wave.

IF THERE is no man-made static to contend with, natural static sometimes can be reduced a trifle by using a short antenna. Reducing the length of the antenna also produces an apparent improvement in selectivity with, of course, a falling off in the strength of the signals from distant broadcast stations. A short antenna generally has less high frequency resistance than a long antenna, and because it has less effect on the first tuned stage in the radio circuit there is an actual improvement in the selectivity of this circuit with a short antenna. But the actual improvement is small compared with the apparent improvement, which is simply the result of the reduced signal strength.

While no change in the antenna length can affect any material improvement in the ratio of broadcast signal strength to natural static strength, it often is possible to reduce the interference caused by man-made static.

Possibilities along these lines depend on the location of the source of the man-made static; that is, the location of the machines that are causing the trouble. If the man-made static is produced by the overhead trolleys on an electric railway and is radiated from the overhead wire for miles in every direction, or defective apparatus such as a partly broken-down insulator on the high tension power wiring is similarly radiating static for long distances, changing the antenna can have but slight effect.

There are, however, thousands of cases where the man-made static is produced by some piece of electrical apparatus in the same building with the radio receiver. This is the situation in many apartments using elevators and other electrical apparatus. In such cases, increasing the length and height of the antenna frequently will improve reception from distant and local stations alike. A large part of a long antenna may be outside the zone of influence of the man-made static. Then, when a strong signal is picked up, it is possible to turn down the volume control to the point where the set is relatively insensitive to the man-made static picked up from the portion of the antenna affected by the local machinery. Figures one and two illustrate this possibility. Figure one shows an outdoor antenna with the shaded area indicating the extent of the man-made static produced by some piece of machinery in the house. Note that much of the outdoor antenna is outside this zone of influence. Figure two shows exactly the same situation except that an indoor antenna is substituted for the outdoor antenna. Note that in this case the entire antenna is within the zone of influence of the locally manufactured static, and more static will be picked up while at the same time less signal strength is obtained from the broadcast station.

OF COURSE, physical limitations in many cases make possible the erection of an antenna only in one direction and of a given length and height, but where it is possible, it always is worth while to experiment with antennas strung in different directions and at different heights. A single-wire, horizontal antenna often displays marked directional characteristics. When it does, it almost always receives best the station opposite to the direction toward which the free end points. Natural static frequently displays some directional characteristics and in many localities tests may reveal that some desired station can be received with much less static interference merely by a shift in the direction, height, or length of the antenna.

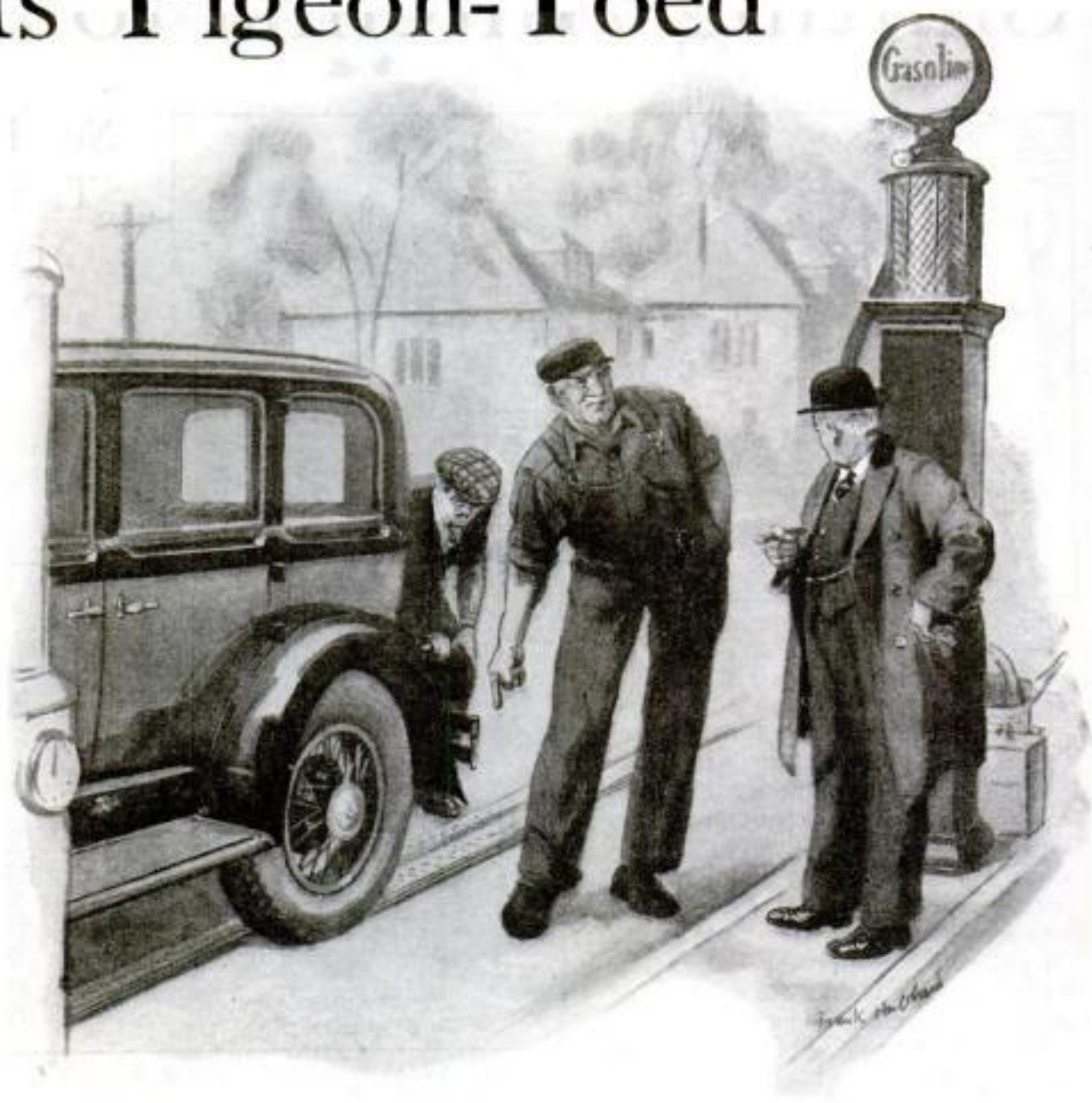
It may be well to point out that there is no particular merit in the shape of the antenna nor the material of which it is made, provided the wire is of some non-magnetic material of good conductivity.

Your Car Is Pigeon-Toed

Gus explains why the front edges of tires should be a fraction of an inch closer than the rear

By

MARTIN BUNN



"Look at the tracks of your tires," Gus said. "The wheels are out of line. Either you sprung the frame when the wheel hit the curb or you moved the back axle on the spring."

"THIS sure is my lucky day, Gus," smiled Pop Topham as he stopped his shiny new car in front of the Model Garage.

"What did you do—sell that corner plot for about twice what it's worth?" Gus Wilson winked at his partner, Joe Clark, as the two garage men stepped up to Topham's car.

"Oh, nothing as good as that," replied Topham. "But I just skidded into the curb and didn't hurt the car. Usually when I get something new, I manage to ruin it, first time I use it. A fellow crumbled a mudguard on my last new car before I'd gone ten miles."

"I remember that," said Gus. "Sorry to hand you bad news now, Mr. Topham, but that skid did do some damage. Look at the tracks of your tires. The wheels are out of line. Either you sprung the frame when the wheel hit the curb or you moved the back axle on the spring."

"I might have known it!" Topham groaned.

Gus leaned over to inspect the rear end of the chassis. "I guess you're lucky after all," he said at last. "It's not a sprung frame. Run your car inside and we'll line up the axle on the springs again."

Joe swung the door open and Topham drove in. Gus followed, carefully examining the tracks of the tires.

"Have you noticed anything funny about the steering?" he asked.

"It doesn't seem to steer so very easy."

"That's because the front wheels are out of line a bit, too," Gus explained. "And from the looks of the running gear, I don't think your front tires are going to last very long."

"What's the matter with them?" questioned Topham. "They look all right."

"There's nothing the matter with the tires, but the front wheels don't line up; and when that's the case, you can figure on buying one new tire after another. Just a minute and I'll show you," said Gus; and he brought out the measuring instrument designed to check the alignment of the front wheels.

"I could do this with a tape measure," he said, "but it's much easier with an outfit like this. See—the front edges of the front wheels are half an inch farther apart than the rear edges. When the wheels are pointed as nearly straight ahead as you can get them they toe out. After I straighten out the rear of the car I'll adjust the tie-rod so that the wheels toe-in just about an eighth of an inch. The front edges of the tires should always be an eighth of an inch nearer together than the rear edges."

"How do you know where to make the measurements?" asked Topham interestedly. "The wheels are tipped anyhow, and I don't see how you figure where to apply the tape."

"I'll say they're tipped," said Gus. "The front wheels should have toe-in and camber and the king-pins should have a certain amount of caster."

"They seem to need lot of things all at once," said Topham, gloomily. "What do all of those words mean?"

"Well," said Gus, "camber is the amount the wheels tip—usually about two degrees. The outer end of each axle drops a little from the horizontal so that where the tires touch the ground they are closer together than at the top. The idea is to have the point where the tires hit the road brought in under the steering knuckle. That makes steering easy. Modern cars don't have as much camber as the old-timers. They're made with better steering knuckles now and more ball bearings."

"What's the caster?" Topham asked.

"The caster is the tipping of the king-pins so that the top leans back. It's kind of hard to explain, but if you haven't any caster, steering is mighty hard. The center line of the steering axis in an automobile is the king-pin. If you carried it on to the ground in theory, it ought to be ahead of the point where the tire makes contact with the road. You know how you can ride a bicycle with your hands off the handlebars? That's due to the caster action. So is the tendency of an automobile's wheels to straighten out after being turned. I once drove a car fifty miles that had an axle assembled all wrong. There wasn't any caster or tipping of the king-pin. By the end of the trip both arms were lame just from trying to keep the steering wheel straight."

"Good grief!" gasped Topham. "I never realized there was so much to the steering gear of an automobile."

"There's more yet," Gus smiled. "Even if the caster and camber and toe-in are right, you have trouble if the wheels wobble. What's (Continued on page 154)

GUS SAYS—

WHEN you're figuring on buying a car remember that swell furniture in the salesroom don't make the car run any better or last any longer. And when you need service, as you're bound to after a while, you don't get it in the salesroom. What counts is whether the agency has a service station fitted with modern tools and manned by real mechanics. A fancy salesroom is all right in its place, but the wise buyer always investigates the service station.

POPULAR SCIENCE HOME WORKSHOP

Articles on Furniture, Models, Toys, Sporting Equipment, and All Forms of Craft Work—Better Shop Methods—The Shipshape Home

Fig. 1. The cabinet has a covered drawer which serves as a desk for the telephone.

Making a Convenient Telephone Cabinet

By WILLIAM W. KLENKE

FEW pieces of homemade furniture can equal the telephone cabinet illustrated above in convenience and attractiveness. Its construction is such that it can be made easily in a motorized home workshop; or, if no lathe is available, the legs can be turned to order at a wood turner's or cabinetmaker's shop.

This project has been included in our series of articles on the use of woodworking machines especially to demonstrate the use of small portable sanding machines, which are designed to bring any surface to the degree of smoothness required for the application of a really high-grade finish. Two types of these machines are illustrated, a drum sander in Fig. 2 and a belt sander in Figs. 3, 5, and 6.

The importance of thorough sanding should not be overlooked by the amateur woodworker. The finest varnish, lacquer, and enamel will not conceal tool marks or superficial blemishes. Indeed, the finish tends to magnify all defects; hence the necessity for obtaining a perfectly smooth surface before any finishing is done.

All the surfaces, of course, can be smoothed by hand, but the amateur craftsman undoubtedly can obtain better and infinitely quicker results through the use of a portable sander. It can be operated as easily as a hand plane and thus makes sanding more of a pleasure than a monotonous chore.

At the present time there are on the market three principal types of small sanders: the continuous one-piece belt machine, the drum sander, and the disk sander. The last mentioned is operated by means of a flexible shaft and is not used as extensively for cabinetwork as are the other types, which will be discussed in this article.

Each sander has its especially good points, and excellent results can be obtained on either type of machine.

Fig. 2. This drum type of portable sanding machine has a bag which catches the dust.

The continuous belt sander (Fig. 3) has, as its name implies, one piece of sandpaper spliced together in the form of a belt, which revolves around two cylinders. The flat surface of the machine between the cylinders is what serves as a backing for the paper in sanding flat surfaces. Because of the relatively large expanse of surface that comes in contact with the wood being sanded, the maximum allowable cut is somewhat limited with this type of machine.

The belt sander is light and easy to operate and can be used with a great degree of accuracy. One of the advantages of this machine is the ease with which the sandpaper can be changed (Fig. 6).

By using a special table attachment (Fig. 5), the sander can be converted into a bench machine for use in squaring table legs, rails, and similar parts. Curved work can be sanded on one of the cylinders, so that this type is invaluable for sandpapering all varieties of surfaces.

The drum sander (Fig. 2) has a revolving felt-covered cylinder over which sandpaper is placed. The sole of this sander is adjustable for the thickness of the cut desired. It is capable of taking a very deep cut and, of course, can be adjusted for a very fine cut also. Indeed, the cutting capacity of this machine is perhaps its outstanding feature.

Attached to one side of the machine is a large bag which catches the fine dust as it comes from the wood. By removing the sole, this type also makes an excellent sander for concave surfaces.

In constructing the telephone cabinet illustrated in Figs. 1 and 4, almost any furniture wood may be used, but it must be reasonably hard and strong because the legs are turned to a small diameter. A good material is maple or birch, which can be stained or lacquered to suit the individual taste and to match walnut or mahogany.

Fig. 3. The continuous belt type of sander is operated much as an ordinary hand plane and just as easily.

The steps in the construction of the legs and rails are as follows:

Step No. 1—The Stock. Get out all stock on the jointer and circular saw to the sizes indicated in Fig. 4.

Step No. 2—Turning the Legs. Turn the legs to the design, being careful to obtain clearly defined, well-matched profiles.

Step No. 3—The Joints. Either mortise and tenon or dowel joints may be used. If the simpler dowel joint is preferred, all

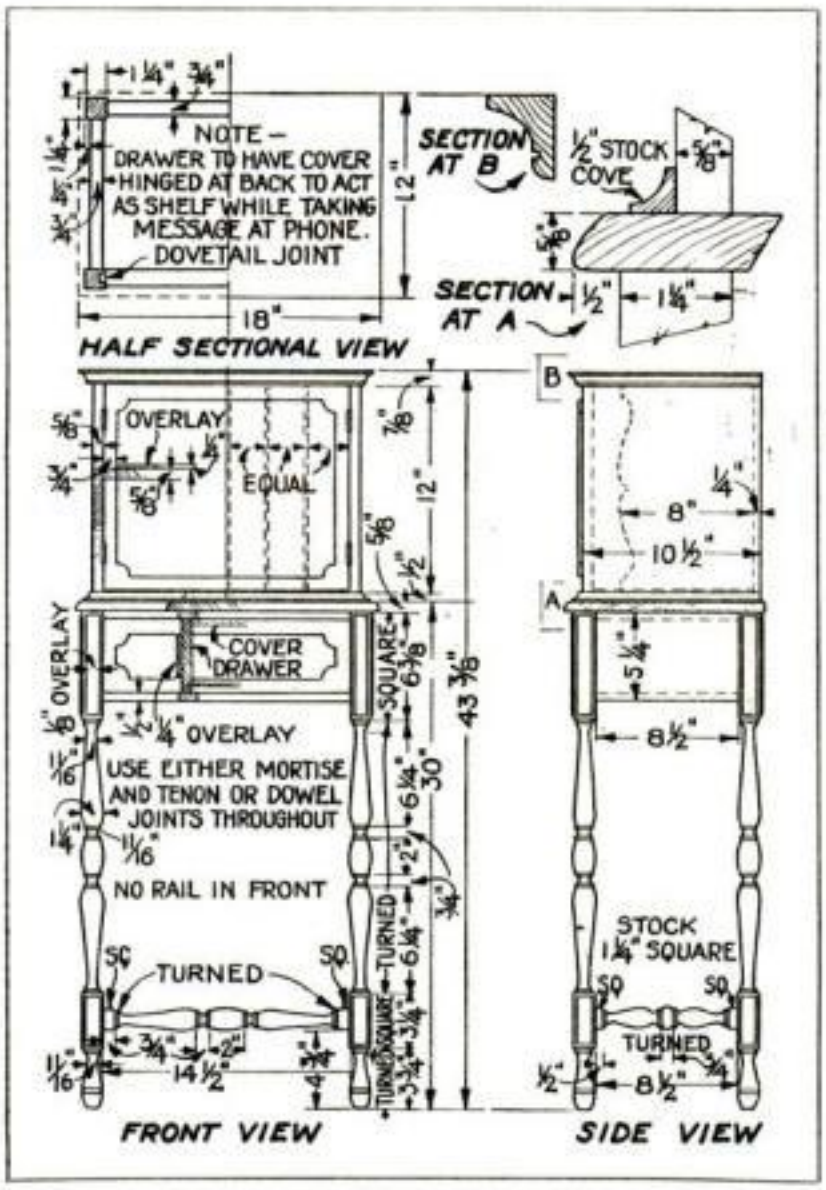


Fig. 4. Dimensions of the telephone cabinet. Any reasonably hard wood can be used in the construction of this project.

the holes can be bored quickly and accurately in the lathe. If you choose the mortise and tenon type of construction, the mortises can be bored out ready for the hand chiseling operation, and the tenons can be speedily cut to shape on the circular saw.

Step No. 4—Assembly. First glue together the legs and rails forming each end of the table, and allow the work to dry between clamps. After the glue is hard, assemble the remainder of the table, being careful to get all of the parts square and in line.

Step No. 5—The Top. If your stock is not wide enough so that one piece will serve for the top, it will be necessary to join several pieces together. True all of the edges on the jointer and lay out the pieces for doweling. Glue them together; and when the glue is hard, dress the surface and smooth it with the portable sander. The top then can be fastened to the legs and rails by any method preferred.

The construction of the cabinet portion is as follows:

Step No. 1—Stock. Cut the stock to size on the jointer and circular saw, and use a jig saw to cut the three telephone book partitions to shape.

Step No. 2—Joints. On the circular saw, cut all the necessary joints, following the working drawing. A rabbet should be cut in the sidepieces to receive the back.

Step No. 3—Assembly. Make a trial assembly of the parts to be sure that they fit, and then assemble and glue the sides and nail the back in place.

Step No. 4—Cleaning Up. A portable sander, used as illustrated, will save a great deal of labor and besides do a perfect job on the broad surfaces of the cabinet.

Step No. 5—Miscellaneous. Glue on the various overlay panels, nail the molding in place, and cut the drawer stock on the circular saw. Hang the doors after all other operations have been completed.

Step No. 6—Cleaning Up the Entire Project. Remove any excess glue with a sharp chisel and thoroughly sandpaper the entire cabinet with No. 0 and No. 00 sandpaper, slightly rounding all the edges.

Step No. 7—Finishing. This cabinet, with its overlay on the doors, drawer, and sidepieces, and with its graceful legs, is an excellent project for the application of an antique finish or a two-tone effect in lacquer.

To obtain an antique effect, the wood should be stained to imitate mahogany, walnut, or antique maple. I prefer to use a water stain, but prepared penetrating stains will also give good results.

When the stain is dry, apply a very thin coat of white shellac. Then sandpaper the entire surface with No. 00 paper to cut the raised fibers. Sandpaper all the high parts of the turning, the edges, and any place where natural wear would occur until you are almost down to the bare wood. Follow with a coat of paste wood filler of the correct shade. The filler gives a mellow tone to these artificially worn places. Allow ample time for the filler to harden and apply three or four coats of white shellac, rubbing each coat lightly with sandpaper and the last coat with powdered pumice and oil (crude oil is to be preferred). Of course, if you have a spraying outfit, lacquer can be used in place of the shellac.

In an article in the May issue, the construction of the bench will be given.

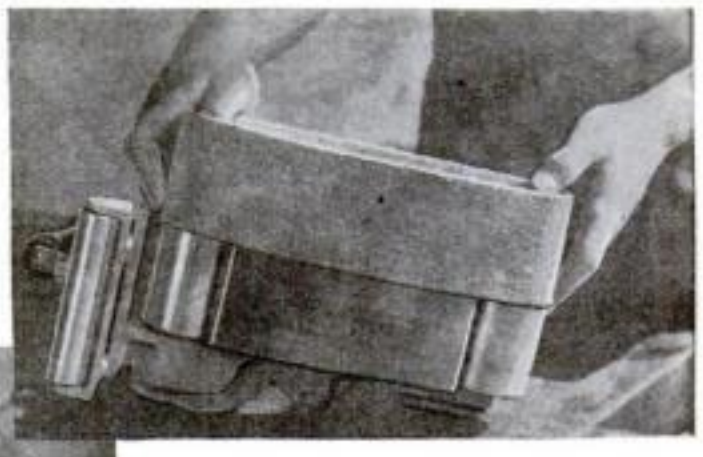
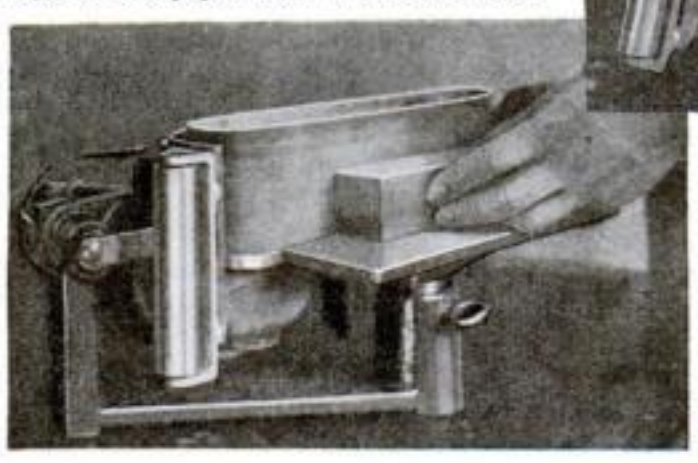


Fig. 5 (below). Table attachment for use on a belt sander. Fig. 6 (at right). Removing the sandpaper from the belt sander.



This is the ninth of a series of articles in which Mr. Klenke, through the courtesy of various manufacturers, is demonstrating the use of many new motor-driven home workshop machines of both the combination and individual types now used so extensively.

How to Make a Railing for a Motor Boat Model

BEING unable to obtain screw eyes suitable for use as stanchions in the construction of a railing for a motor boat model (that shown on POPULAR SCIENCE MONTHLY Blueprints Nos. 63 and 64, listed on page 111) and not wishing to pay the high price for regular model stanchions, the author made neat substitutes from the pins of ordinary hinges (see Fig. 1).

Fig. 1. By selecting the proper size hinge you can make railings for a model of any size.

The hinges can be obtained in various sizes at five or ten cents a pair. By selecting the right size, it is possible to make a railing for a large, small, or medium size model.

The pins are removed from the hinges and the caps or knobs pulled from the pins with a pair of pliers (Fig. 2). This is done to simplify the drilling of the holes for the railing. The author tried to drill the holes with the caps on the pins but found it difficult because the pins are harder than the caps. The pins are then cut to the right length and inserted in holes drilled in the deck.

After the caps have been slipped on the wire railing, they are moved to the correct position, and the railing is bent to the desired shape.—HENRY MARTIN.

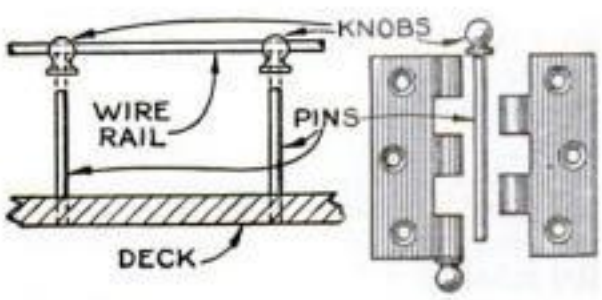


Fig. 2. The knobs are removed from the pins to allow the holes for the rail to be drilled.

Stagecoach Model Making

OLD coaches were always decorated in brilliant colors. The *Diamond Tally-Ho* had a cardinal red body and a yellow carriage ornamented with black striping.

By EDWIN M. LOVE

TO MEET the almost unanimous wishes of those readers who have written about our new hobby of stagecoach model making, the next model will be a covered wagon.

After a long search, Mr. Love found a well-preserved prairie schooner stored away in the Pony Express Museum at Pasadena, Calif. He has made drawings and is building a model. When it is completed, it will be presented to the readers of POPULAR SCIENCE MONTHLY.

WITH the main structural details of the *Diamond Tally-Ho* model completed, our little stagecoach begins to take on the lines of the romantic old coach from which it was copied.

All that is left to do is to attach the platforms, upholster the interior, place the seats, and apply the paint and decorations. As soon as this has been done and we have supplied our model with a suitable base, we shall be able to look at it and almost see the old coach rocking its adventurous way over the treacherous road between San Diego and Julian in California.

In order to simplify the construction as much as possible, three blueprints containing full size drawings of all the parts have been prepared. They can be obtained by sending twenty-five cents for Blueprints Nos. 115, 116, and 117 (see page 111).

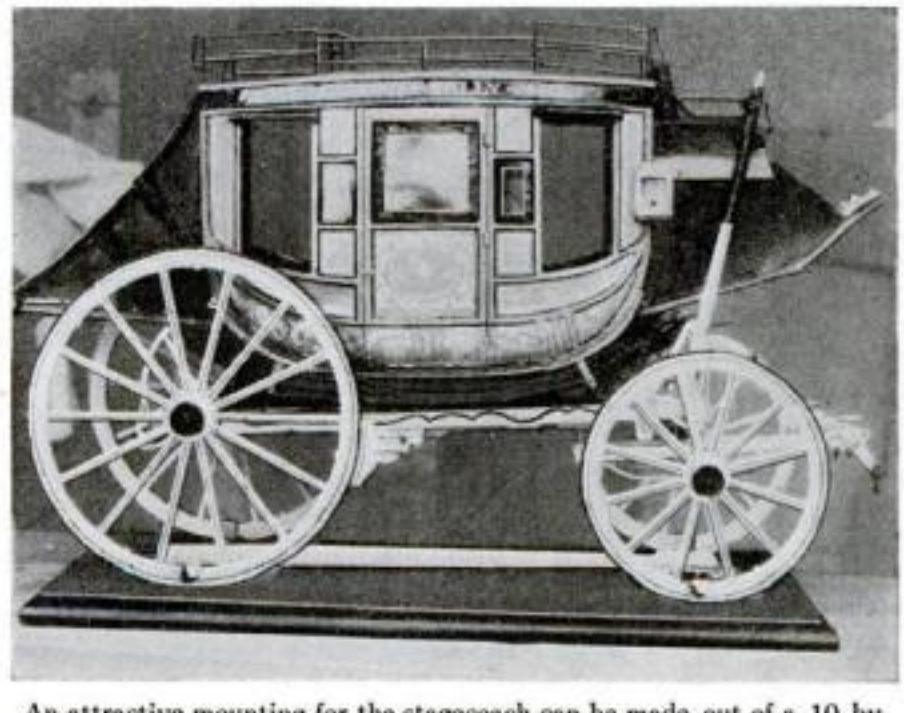
BODY. *Platforms:* Brads can be used as pins in assembling the hinges. Support the front with 1/16 by 1/4-in. leather straps laced through triangles attached to the foot irons and the strips under the ends of the seats.

Support the rear platform with cheap 1/8-in. watch chains, which can be purchased in any ten-cent store. S-hooks bent from wire fasten the upper and lower ends to the eyes. The left-over pieces of chain serve as the stay chains which hang from the front axle and doubletree hooks.

The suspension straps are 1/16 by 3/8 in. and are threaded through the bracket clevises until there are eight thicknesses with enough slack to hold the bottom of the body sides 5 in. above the ground line. Drive brads through the straps, clinching them underneath to hold the straps tightly together. Four clips placed in the rabbets on the underside of the body clasp the straps, and brads serve as retaining pins. To get both straps the same length, stretch the first one tightly on a board, place nails to hold the ends, and wind the second strap directly above it.

Sashes: Make the frames of thin cardboard, use celluloid for the panes, which are glued on the inside, and paint them black outside and red inside.

Rub Irons: These are made of cardboard, are 3/4 in. long, and are glued to the under and outer reach corners where the front wheels, in swiveling around, would rub. Similar plates protect the straps. On the forward panel of the body three irons are nailed. These can be cut with a small cold chisel, the bars being filed half round outside and bent so as to conform to the curve of the coach body.



An attractive mounting for the stagecoach can be made out of a 10 by 17 1/2 in. piece of plywood. Note the tongue placed under the carriage.

PAINTING. *Body:* Glue twelve cardboard strips on the roof (for cleats) and give the body three coats of cardinal red, using four-hour enamel and a flat 3/8-in. lettering brush. Strain the paint through cloth and dust the body with a brush before each coat. Allow the third outside coat to dry thoroughly and sand lightly with split 6-0 sandpaper wetted with water. Wipe the surface clean with a damp cloth, let dry, dust, and apply the last coat of strained paint.

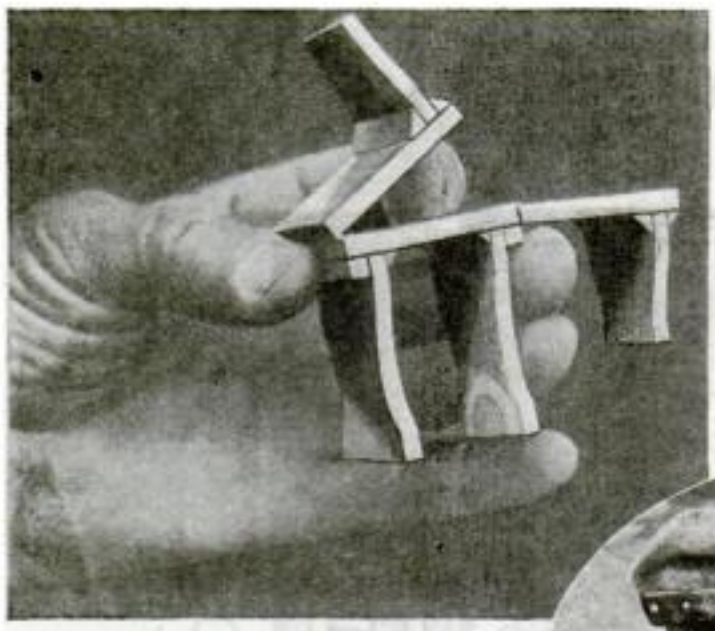
Paint the title space and panel bar bevels black. Lay out the scroll ornament design on paper, rub the back of the paper with a lead pencil, and transfer the design to the body. Mix a few drops of clear four-hour varnish with metal leaf gold powder and paint in the design, using a fine round brush. Do not try to use the gilding too thin, for, over the gloss of the red, it may tend to draw away. When dry, outline the design with black. Some may find it easier to use India ink applied with a small round-pointed speed-ball pen instead of paint applied with a brush.

Be careful to center the title lengthwise in its space (not forgetting the period, which was always used with titles in olden days), and show a little wider margin at the bottom than at the top.

Inside each panel paint 1/16-in. gold stripes placed so as to be 3/32 in. from the bars.

Carriage: Dilute the yellow enamel with turpentine and carefully pour it on, catching the paint in a broad, shallow, clean pan. Two or three coats can be given as fast as they get tacky. Stroke off the excess with a brush. Enamel the wheels in the same manner and stroke the felloes and hubs. The hubs can be thrust on nails and the nails driven into a wall while the enamel is drying.

Striping: Rub a little of the gloss off with split 6-0 sandpaper, sketch the stripes with a pencil, and paint them black with a small brush, making



Above: The sections that make up the center seat are hinged by gluing a strip of cloth across the top before the upholstery is applied. Right: The completed seat.

lines 1/16 in. wide. A round-pointed speedball pen charged with India ink may be substituted for the brush, if desired. Wheel spokes, hubs, doubletree hounds, and other parts having straight stripes or stripes parallel to the edge are decorated by lashing a ruling pen to a thin strip of wood so that its tapered end will be a little below the point. A wooden wedge for clearance adjustment should be thrust between the pen and the wood. Use ink in the pen, with a wooden strip bearing against the part, thus acting as a guide.

Tires, hub bands, and singletree ferrules are painted black.

When the paint is dry, screw on the wheels and mount the body permanently.

RAILING: For this, tinned radio bus wire may be used. Make a form by driving nails into a board for use in holding the pieces for soldering. The handgrips, which incline 45 degrees, can be held with a pair of pliers while being soldered. File points on the posts and force them into holes drilled into the roof for the purpose.

The seat-rail rods enter sockets in both the seat and body, having the upper rod inside the brace, and the other rod outside.

LEATHER: Imitation leather may be used in all cases. The writer used a lady's bag that had been discarded. Cut paper patterns, allowing ample material to fold around the straps and chains. The lower edges are fastened to the platform and seat edges with 3/32 in. wide, No. 14 gage metal straps held in place with small brads. A boot cover, wide enough to lap 3/8 in. over the sides, hangs from a wire rod supported by eyes under the top at the back of the body.

The driver's seat and back cushions can be made by covering linoleum blocks with leather.

UPHOLSTERY. *Seat Backs:* Strips of 1/4-in. linoleum, 2 1/4 in. wide and long enough to fit, form the 16 vertical half rolls which are gathered in 15/16 in. below the upper edges. Trim the linoleum by cutting the back. The dark green velvet is held in place over the rolls with shellac. Press the cloth into the folds with the back of a knife blade, beginning at the center and working toward the ends, holding the finished fold tightly until the one directly ahead is made. Paste the edges smoothly over the backs. The backs are glued in place after the seats have been fitted.

Carpet: Velvet is used as carpet and is glued to the entire floor of the body.

Seats: Fit a cardboard pattern 2 1/4 in. wide between the sides at each end, and to these shapes make the 3/4-in. thick wooden seats. Square lines across the tops, making divisions like those on the backs, and continue them down across the front. Cut saw kerfs 1/8 in. deep on these lines, carve the rolls, and cover the seat with velvet. In placing the seats, make the front 3/16 in. higher than the back and tack a small wooden cleat under each seat to prevent it from sliding forward.

Sides: Fit linoleum pieces having two horizontal 3/16-in. wide half rolls under the large windows and another 11/16 in. wide, which curves parallel to the window sills. These are continued across the doors. The remaining space below the windows is covered with muslin and painted red.

Center Seat: The drawing and photographs show the general construction of this seat. The end sections, which rest on the door sills, fold back to admit passengers to other seats. The cloth hinges are glued on the top before adding the cushions. Nail the center legs through the body floor, after placing the seat so that the rear edge is 3/8 in. from the rear edge of the doors.

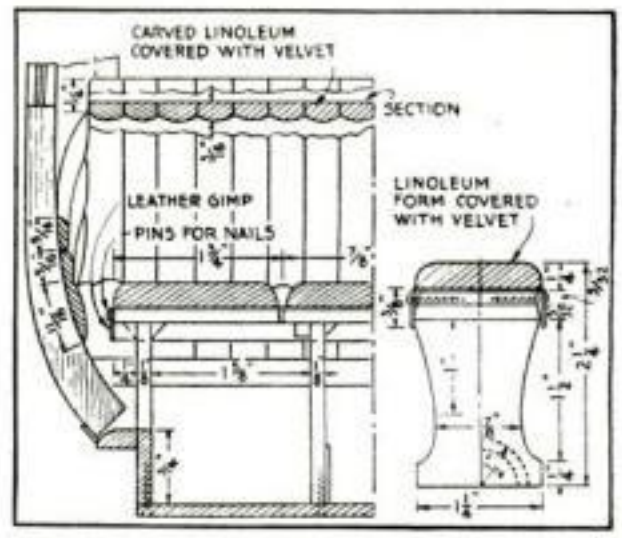
MOUNTING: The model base is made from a piece of 3/4-in. five-ply stock, 10 by 17 1/2 in. Nail a 3/8 by 5/8 in. molding on the edge to hide the plies. Set the nails and fill the holes with plastic wood. Finish with four coats of black enamel, well rubbed with pumice stone and water.

Stand the model on a board, with the wheels centering on the width and the length, and clamp them in place with leather-lined metal clasps screwed to the base. Lay the tongue under the model.

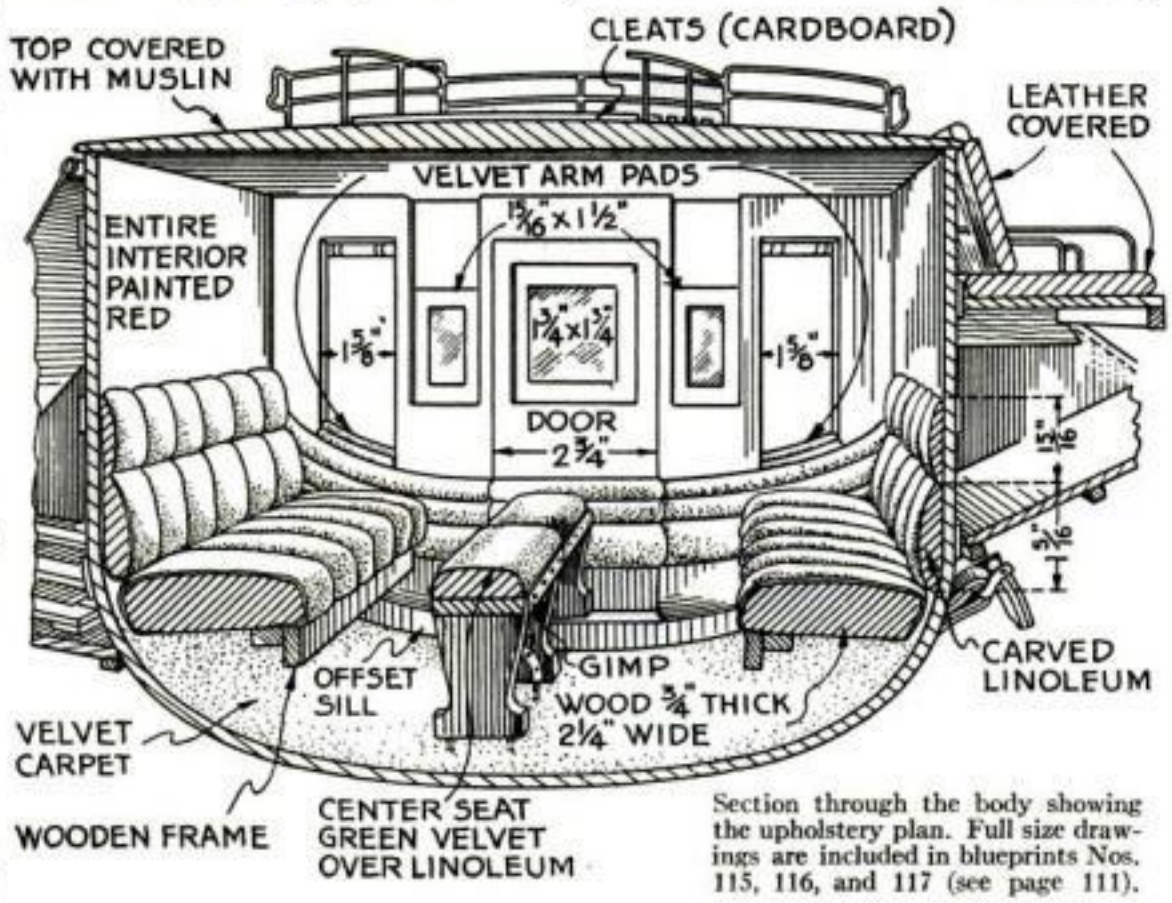
A few points as to the finishing touches: See that the doors fit flush, that the boot buckles are neatly clinched, and that the seat cushions are in their proper places. Adjust the wheels so that the under spokes are vertical, and the front and back wheels are parallel to the base sides.

The tongue can be placed, head forward, under the carriage and can be permanently fastened to the plywood base with small metal clasps similar to those that are used to hold the wheels in place; then the tongue will not be lost.

In order to be sure that the painting on the model is perfect, go over the entire body and carriage and remove any unevenness that may be present in the striping or the lettering and retouch these spots with a small artist's brush. Be sure that the windows are free from dirt and paint.



Construction of the upholstered end and folding center seats and plan of side upholstering.



Section through the body showing the upholstery plan. Full size drawings are included in blueprints Nos. 115, 116, and 117 (see page 111).

All of the carriage building terms which are not self-explanatory are clearly marked on Blueprints Nos. 115, 116, and 117, which contain full size drawings of all of the parts. In making such a complicated model as this, full size drawings are essential.

Tycos—

Goes with the Doctor on His Midnight Mission · · · Roars into Icy Arctic Wastes with Byrd · · Stands Guard by Seething Cauldrons of Steel · ·

by Frank M. Herbert

FAR down in the frozen antarctic a plane carrying a little band of zealous scientists roars into the air for a dash to the pole. Along their course mountains of glistening ice and snow rear a dazzling and dangerous barrier. But science, by perfecting the plane, has put them in the air—has provided the most delicate and sensitive of instruments to keep them safely on their way—making possible the most accurate of surveys. Without these little instruments in such blinding wastes of snow, they might be losing precious altitude, losing direction, failing in the survey which means so much to those who will come after. They watch, climb, safely skim the highest peaks, and return to their base with the first aerial survey ever made of the wild antarctic.

And the special surveying Aneroid Barometer they use in this pioneer observation is provided by Tycos.

NOTHING man has made is so delicately adjusted, so sensitive as man himself. He is peculiarly dependent upon heat—both the heat of the sun and heat he generates within himself. His temperature must not vary more than a few degrees from the normal—98.6 degrees F. Even a slight variation may foretell serious danger.

Now you can see why the doctor's first step in diagnosis is to take the sick man's temperature. He thrusts a little thermometer under the tongue, and waits till it registers the patient's temperature. Without the thermometer he could not prescribe intelligently. Remember that a variation in temperature from the normal of only one degree is a danger signal; two degrees is a forecast of illness that may be serious, even fatal.

Life and death may depend on the correctness of the little instrument that the physician places under your tongue. If it is wrong . . . !

On these highly accurate thermometers used by the doctor is engraved the name Tycos.

BEFORE Pasteur discovered the deadliness of bacteria, babies died with various unclassified and somewhat mysterious ills. They died because the cow's milk they fed upon was swarming with invisible disease germs. Pasteur showed that heat killed the germs and made the milk safe to drink. That is why milk is "pasteurized," or in other words heated up to a certain point.

The temperature to which the milk is heated must be carefully maintained. If it is too low the germs are not killed; if it is too high the milk is cooked, and hard to digest.

Thousands of gallons of milk flow through a heater in the modern dairy. The temperature rarely varies even a fraction from the critical degree. It is automatically controlled by a wonderfully accurate instrument which regulates the amount of steam supplied to the heater.

On the face of that instrument stands the name "Tycos Temperature Regulator."

IF ONLY one bottle of homemade catsup out of twelve spoils, the housewife has a good average. But a canning factory might face ruin if even one per cent of its products went bad. Every can of corn on the grocer's shelves must be as good as every other one.

Vegetables must be cooked when they are canned. Most of them contain indigestible raw starch. So, the canner must cook his corn. A metal rod dips into the kettle. It is like your finger—that rod; it *feels* how hot is the corn. With the slightest rise or drop in temperature it signals back to a valve on a steam-pipe. "Turn off the steam," it says if the corn is too hot; or "more heat," if the temperature falls. And the regulator responds instantly by moving a valve. No tired workman is asked to watch the temperature at 5:30 P.M., when he is thinking of going home. The regulator is never tired. It never allows the temperature to vary. The cans in which the vegetables are contained are sterilized. In other words, all the germs killed by heat. Without thermometers the canner would not know whether the temperature is high enough to kill all germs. Some of the cans would spoil on the shelves of the retailer.

On the heat-measuring devices the canners use is the name Tycos.

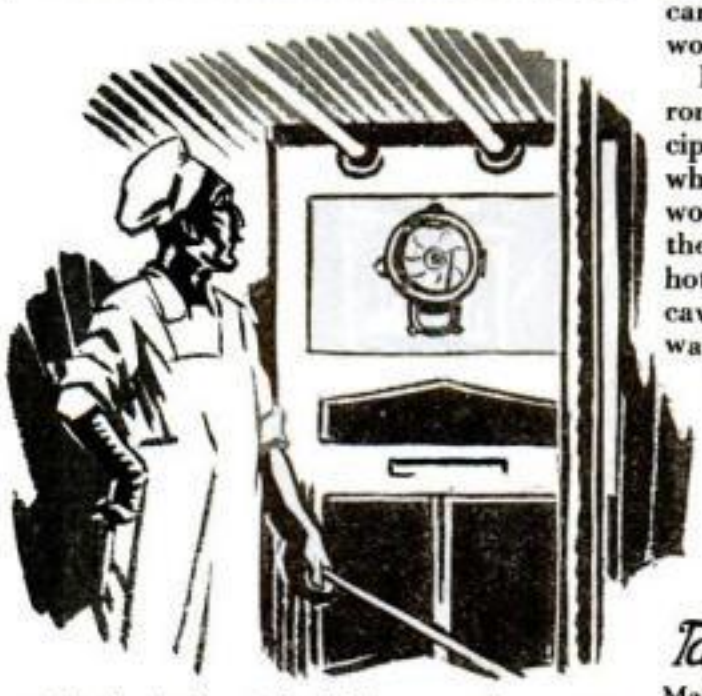
EVERYTHING made of rubber is vulcanized — everything from an automobile tire to an elastic band. When rubber is vulcanized it is mixed with sulphur or other chemicals. The effect is magical. The properties of the rubber

become wonderfully changed. The result desired depends on the amount of chemicals added and on the time and temperature control. Without heat the vulcanizing substances could not be digested by the rubber. But the heat must be regulated. Every vulcanizing apparatus must have its thermometer and temperature regulator. Without the thermometer there would be no rubber industry — no insulated submarine cables, no automobile tires, no vulcanite utensils, no electric insulators made of rubber.

In the great rubber factories, where heat regulation is so vital, Recording Thermometers and Regulators are used that bear the name Tycos.

THERE are almost as many kinds of steels as there are kinds of wood. Add a little chromium, or nickel, or tungsen, or vanadium—a mere pinch of any one of a dozen different elements — and you produce an alloy-steel with perhaps valuable properties. But without "heat treatment," as it is called, there would be no modern science of metallurgy, no inexpensive automobile. It is heat treatment that makes it possible to produce an alloy-steel axle from which an eighty-ton locomotive can be suspended; to pull a valve-stem out like rubber in a testing machine; to obtain a gear with a surface so glassy-hard that a microscope must be used to detect the wear to which it has been subjected after running ten thousand miles; to manufacture a brake-rod or a steering-knuckle that can be operated a hundred thousand times without weakening.

But heat treatment implies careful heat measurement. The furnace in which the parts of an automobile are heated must be



watched. And watched they are—by a man who never sees them. He sits in front of a series of electrical temperature recorders, called Recording Pyrometers, perhaps hundreds of feet from the furnaces. Each recorder is connected with its furnace. If the temperature of a furnace rises or falls ever so little the man at the temperature-control boards knows it. He warns the man in charge of the furnace by flashing an electric light. On the Pyrometers depends the ultimate quality of the parts that compose an automobile. Every great automobile factory has its temperature control room.

On the pyrometers that check the furnaces you will find the name Tycos.

IN THE glass factory, the steel plant, the copper smelter, in every plant where furnaces are installed so hot that metal or clay becomes as liquid as water

when subjected to their terrific heat, you will see a man now and then setting up a little instrument on a tripod and looking through a telescope. He is finding out how hot the furnace is. He cannot use any ordinary heat-measurer; it would melt away like butter on a stove.

His instrument is the Féry radiation pyrometer. When you understand the principle of its operation you think of the time when you burnt your name on a piece of wood with a lens. The instrument focuses the heat from a furnace or from a white-hot body. Instead of a lens it has a concave mirror, which operates in the same way. When the heat rays strike the mirror they are concentrated on what is known as a thermo-couple. Now the thermo-couple consists merely of two different metals joined together. When they are heated an electric current is generated; the hotter the junction, the more powerful will be the current. It is easy to see that the current has only to be measured in order to determine the heat concentrated by the mirror on the thermo-couple. That heat may be as high as 3600 degrees F.—hotter than white-hot molten steel. Until the Féry radiation pyrometer was invented high industrial temperatures could be only approximately measured.

On the Féry pyrometers sold in this country appears the name Tycos.

A MAGAZINE of smokeless powder or dynamite is absolutely unsafe without thermometers to detect the slightest rise in internal temperature. A cold-storage plant would be a commercial failure without temperature control. A wholesale baker of bread would be helpless without thermometers to control his ovens. Wherever there is an asphalt-melting tank, a tar and oil still, an ink factory, a paint-making plant, wherever, in a word, there is an industrial process, there you will find a temperature-measuring instrument of some kind.

And upon that instrument you will see the name Tycos.

THE original firm of Kendall & Taylor made only half a dozen different kinds of thermometers in 1851, and those only for household use. But the Taylor Instrument Companies of today, makers of Tycos Instruments,—the largest firm of its kind in the world—produce not only thousands of different styles of thermometers, but compasses, hydrometers, hygrometers, vacuum-gauges, meteorological instruments, aeronautic navigating devices, and blood-pressure instruments. Wherever a pressure indicator or a heat-measurer is used you are almost sure to find that it bears the name Tycos.

A Quaint Old Candle Lantern

How to Make a Copy in Tin and Glass of a Decorative Early American Light

By EDWARD THATCHER

COPIED from a design of Colonial days, the quaint candle lantern illustrated will give the beginner in decorative metal work an opportunity to practice the soldering operations described in the preceding article of this series (P.S.M., Mar. '30, p. 82).

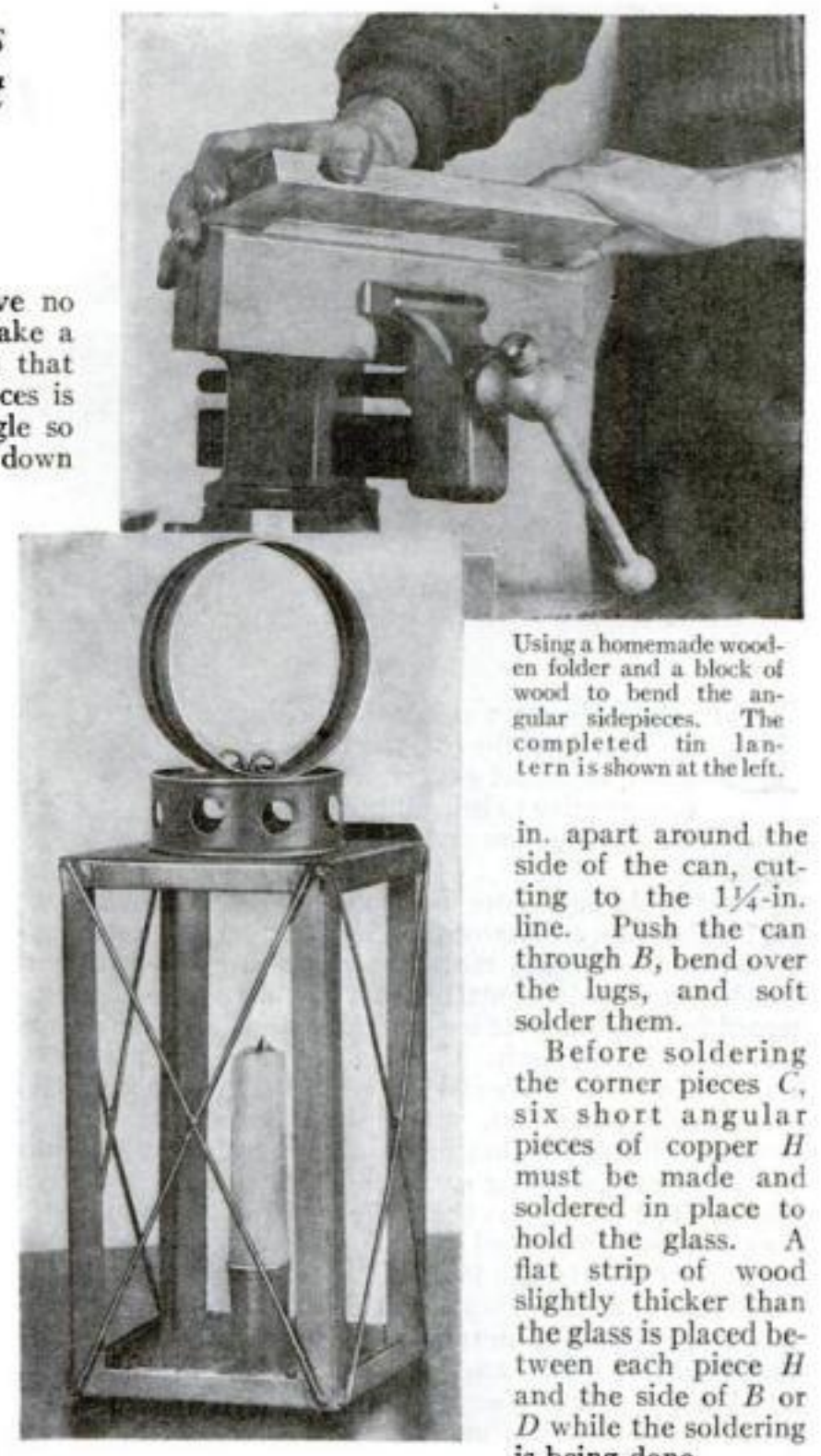
A lantern of this type may be made three-, six-, or eight-sided and of brass or copper, but the beginner is advised to use sheet tin. This is sold in sheets about 20 by 40 in., although by opening out bright, clean, empty tin cans the material can be obtained for nothing.

The top of the lantern may be made from the bottom and part of the sides of a tin can. The ring or handle is a strip of tin, each long edge of which is turned or folded back. It is held to the top by a T-shaped piece of doubled wire, the ends of which are curled over with the pliers. A removable candle socket is provided in the model shown just as in the old lanterns, but an electric light socket may be mounted in its place. The model is painted with jade green lacquer except for the inner part of the sliding back, which is left bright.

To make the lantern, scribe a line 1½ in. up from the bottom of a tin can 3 in. in diameter and cut the can down to this line as at *A* in the drawings below by holding the open end toward you and cutting in a spiral fashion, from right to left. Next cut two 5⅜-in. squares of tin for *B* and *D*. With a wooden mallet bend down the flanges over the square end of a block of wood. In one piece cut a circular opening 3 in. in diameter; this may be done by placing the piece on the end grain of a flat block of wood and using a sharp, narrow chisel.

Form the four angular pieces *C* for the sides from flat strips of tin 1 in. wide and 7¾ in. long. If you have no folder, you may easily make a wooden substitute. Note that one of these clamping pieces is planed off at a slight angle so that the tin may be bent down at slightly more than a right angle; it will spring back to a right angle naturally. Two U-shaped channels of tin for the back of the lantern, which slides up and down, are formed in the same way; then each strip is placed on an anvil, an extra length of tin is placed in the angle, and a mallet used to hammer the piece to the channel shape.

Take up part *A* again, scribe a line 1¼ in. up from the bottom and parallel to it, and another line on the inside of the can 1$\frac{7}{32}$ in. up from the bottom. Blunt the point of a small center punch, lay the cut can on its side on a block of wood, and working from the inside drive up a number of bosses on the 1$\frac{7}{32}$-in. line. These bosses keep the can from sliding too far inside piece *B*. The large ventilating holes are made by placing the cut can on a thick strip of lead supported on a solid steel anvil form, the whole being slipped inside the can when it is being punched or cut with a sharp, small chisel. Also make a number of snips ¼ in. apart around the side of the can, cutting to the 1¼-in. line. Push the can through *B*, bend over the lugs, and soft solder them.



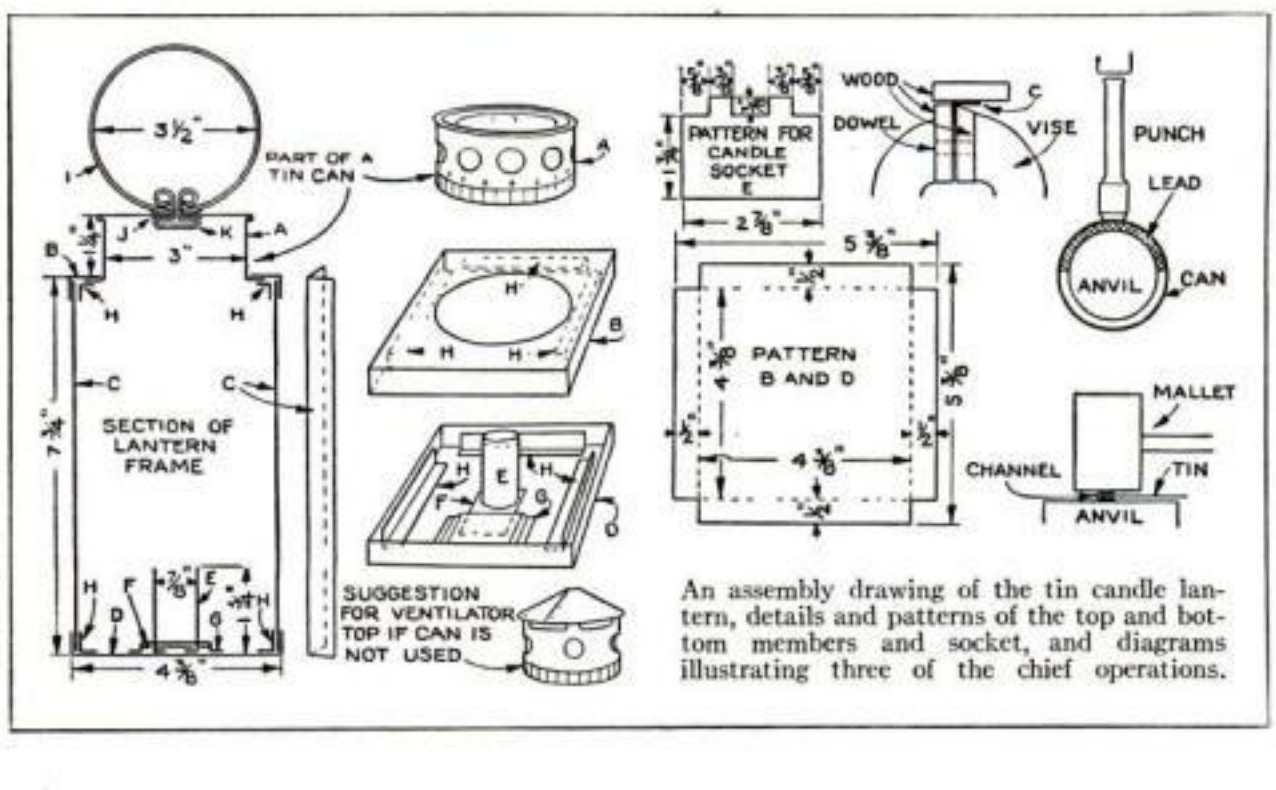
Using a homemade wooden folder and a block of wood to bend the angular sidepieces. The completed tin lantern is shown at the left.

Before soldering the corner pieces *C*, six short angular pieces of copper *H* must be made and soldered in place to hold the glass. A flat strip of wood slightly thicker than the glass is placed between each piece *H* and the side of *B* or *D* while the soldering is being done.

If the lantern is for a candle, a socket *E* should now be shaped over an anvil ⅞ in. in diameter. Notice that this piece is formed with two lugs at the base, which fit into chiseled slots in the strip of tin *F* under the socket. A short strip of tin *G* is soldered at each end to piece *D* in such a way that the tongue of tin fastened to the socket may slip under it. If the lantern is to be used with an electric light, a flat-bottomed socket may be bolted to the bottom.

Now carefully solder corner pieces *C* and the two slides for the back. Cut six lengths of $\frac{3}{32}$-in. galvanized wire to form the guards and solder as shown, using pure muriatic acid as a flux. Next, fasten handle *I* with 1/16-in. wire *K* passing through *I*, *A*, and a tin washer *J*.

Single-thick window glass, either clear or stained, is cut to fit the lantern, and is put in place by bending out the unsoldered portions of the angular pieces *H*, which are then pressed back against the glass in order to hold it in place.



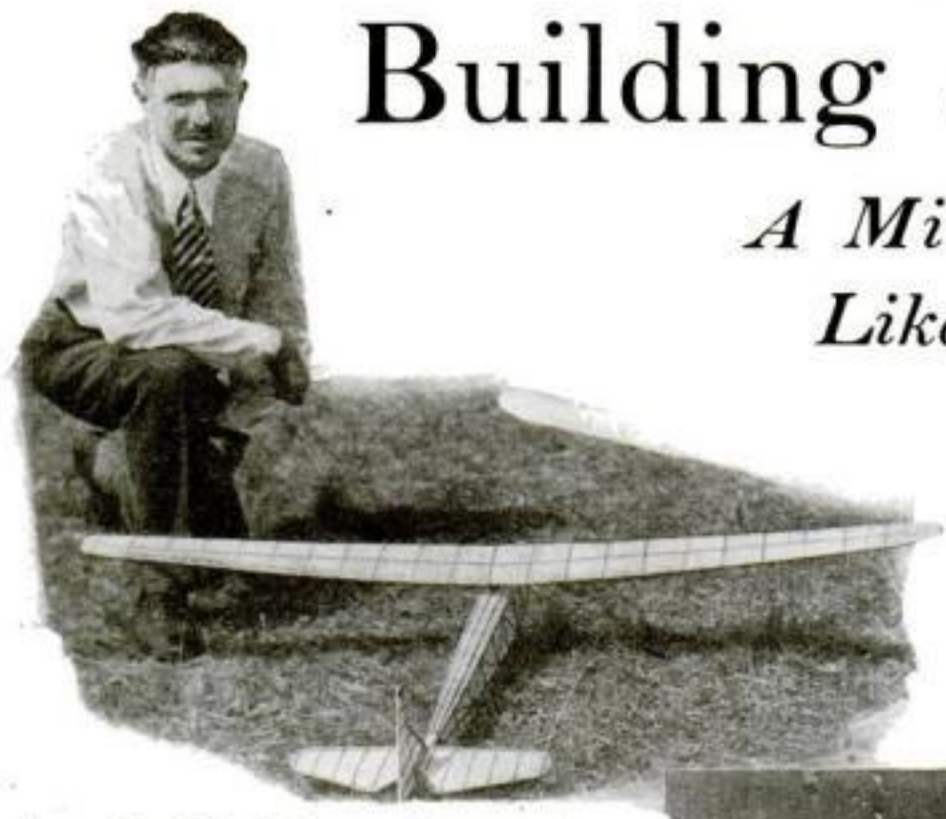
An assembly drawing of the tin candle lantern, details and patterns of the top and bottom members and socket, and diagrams illustrating three of the chief operations.

An article by Mr. Thatcher dealing with the correct methods of doing hard soldering and light brazing is scheduled for early publication.

Building a Model Glider

A Miniature Motorless Plane Like That Piloted by Schulz

By HI SIBLEY



Above: Mr. Neth, designer and builder, with his graceful modified Ferdinand Schulz model.

Below: The fuselage is well braced and strutted to insure strength and remove the danger of twisting and warping in hard usage.

BESIDES being a delightful hobby and pastime, the construction and flying of model gliders present an opportunity to learn the principles of airplane construction and the theory of flight.

What could be a more instructive project for the embryo aviator than building a model of the famous motorless plane in which Ferdinand Schulz broke a world's record by staying aloft for over fourteen hours? Alfred Neth, of Pasadena, Calif., has made a special study of that remarkable glider and, with only a few minor modifications, has reproduced it in the form of the flying scale model illustrated. The model has the characteristic long narrow wings and the streamlined fuselage of Schulz's glider.

One slight addition is a shock absorbing music wire landing gear which protects the glider if it makes any heavy landings. The landing gear also serves as a means of bringing the center of gravity well below the center of the wing—an advantage in all airplane construction.

With the exception of a few small parts, such as the landing gear and wing support, the construction is of balsa wood throughout. The longerons and all of the cross frames are made from ⅛ in. square stock.

The forward ends of the longerons can be bent either by steaming them or carefully heating them over a small flame.

To insure accurate work it will be an advantage to draw the outlines of the side frames and wings on a board and then assemble the parts right over the drawing.

The rounded nose piece is cemented to the nose plate in such a way that the grain of one is at right angles to the grain of the other. This is done to obtain added strength.

In assembling the tail structure, a 1/16-in. panel of balsa is placed on the top and also on each side, and the bottom is provided with a ¼-in. piece which receives the wire tail skid.

Assemble the wing in dry weather and keep it out of the direct glare of the sun until it is completed. Every precaution must be taken to keep it from warping. The completed wing should only weigh 1½ oz. for all of its 62-in. spread.

Gluing on the rice paper requires considerable patience. The glue should be applied lightly with the tip of a finger to one complete side at a time. Stretch the paper as tightly as possible; and when both sides are covered and thoroughly dry, apply a coat of wing dope. When this, in turn, has dried, give it another coat so that the finished job will be drum-tight. Do the drying with the wing laid flat, bottom side down, on a flat surface. If one end or the other has a tendency to lift up, hold it in place with a few small weights.

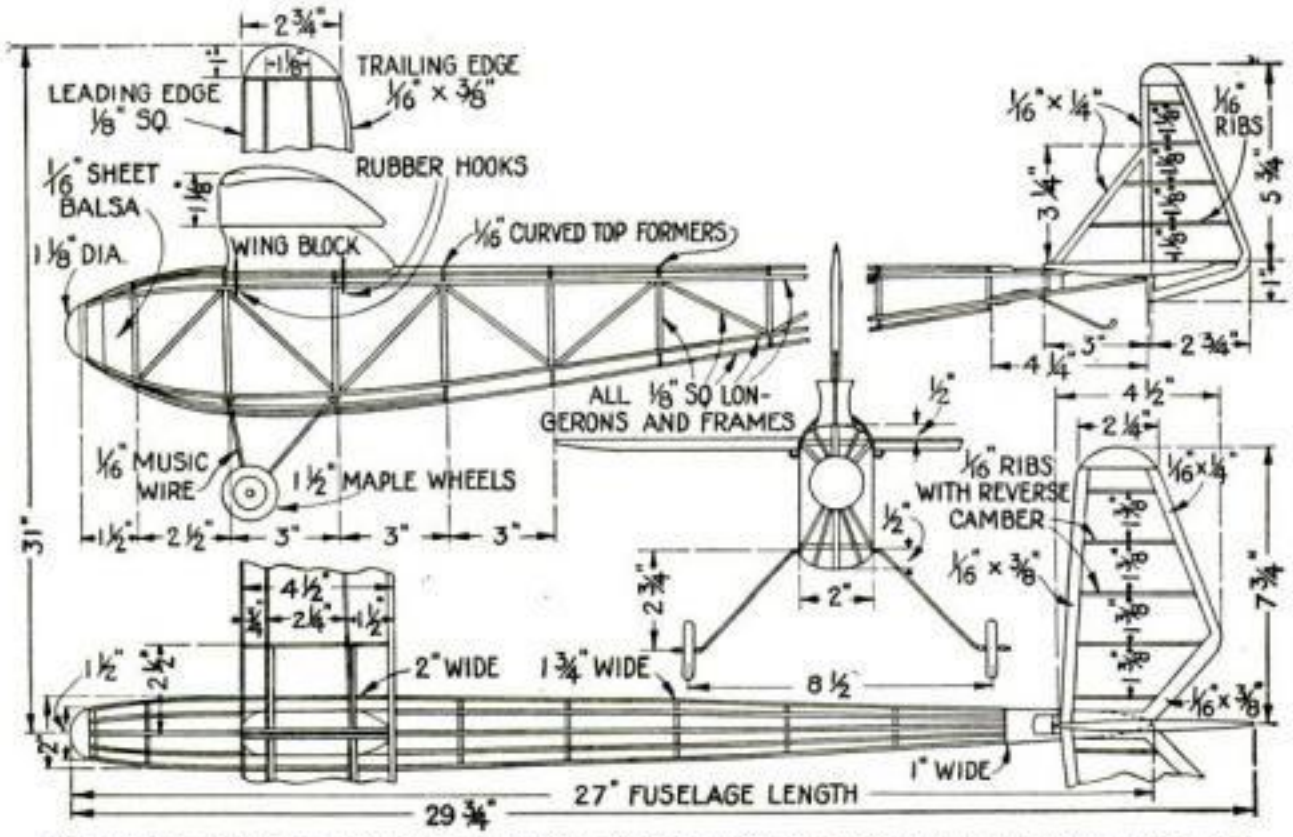
Maple dowels, ⅛ in. in thickness, are secured to the spars of one side and fit into aluminum tubes fastened to the other half. These dowels pass through holes in an aluminum plate (see illustration on page 84) placed in the center of the balsa wing block, which, in turn, is secured to the fuselage by two rubber bands attached to two hooks. Since these hooks straddle the curved top of the fuselage, adjustment of the wing for best performance is a simple matter.

The wing should tilt upward at about 4 degrees to the direction of flight. This is accomplished by slightly tapering the wing block making allowance, of course, for the taper of the top portion of the fuselage.

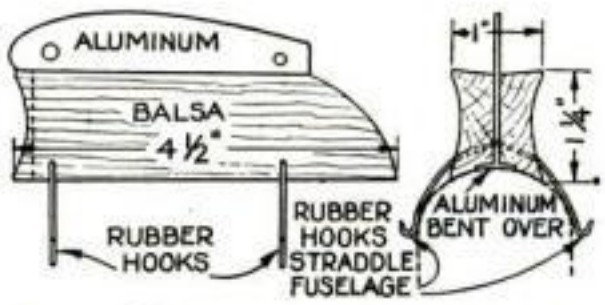
Stiffness is obtained in the rudder construction by the use of streamlined ribs. This design also removes the danger that the rudder will warp under the sun's heat.

The stabilizer is built with a reverse camber which tends to hold the tail down in a slow glide, thus preventing a nose dive. Not infrequently it is found that model gliders have a tendency to nose into the wind at the wrong time. To overcome this, a steering adjustment has been incorporated in this design. It consists of an aluminum plate having five or six holes in the forward end to receive a wire that is cemented to the front end of the rudder and stabilizer assembly; and there is a hole in the rear to receive a pivot.

In trying out the glider, select a group of gently rolling hills or sand dunes along the beach. The wing and rudder-stabilizer unit will have to be adjusted as necessary to obtain the best results. Excellent results were obtained by Mr. Neth in flying the glider over sand. It gained altitude quickly and then settled down



Dimensions of the model. With the exception of the music wire landing gear and a few small metal parts the construction is balsa wood throughout. The [redacted] provided with a dihedral of 1½ in.



Shape and dimensions of the wing block. Note the hooks at each end to receive the rubber.

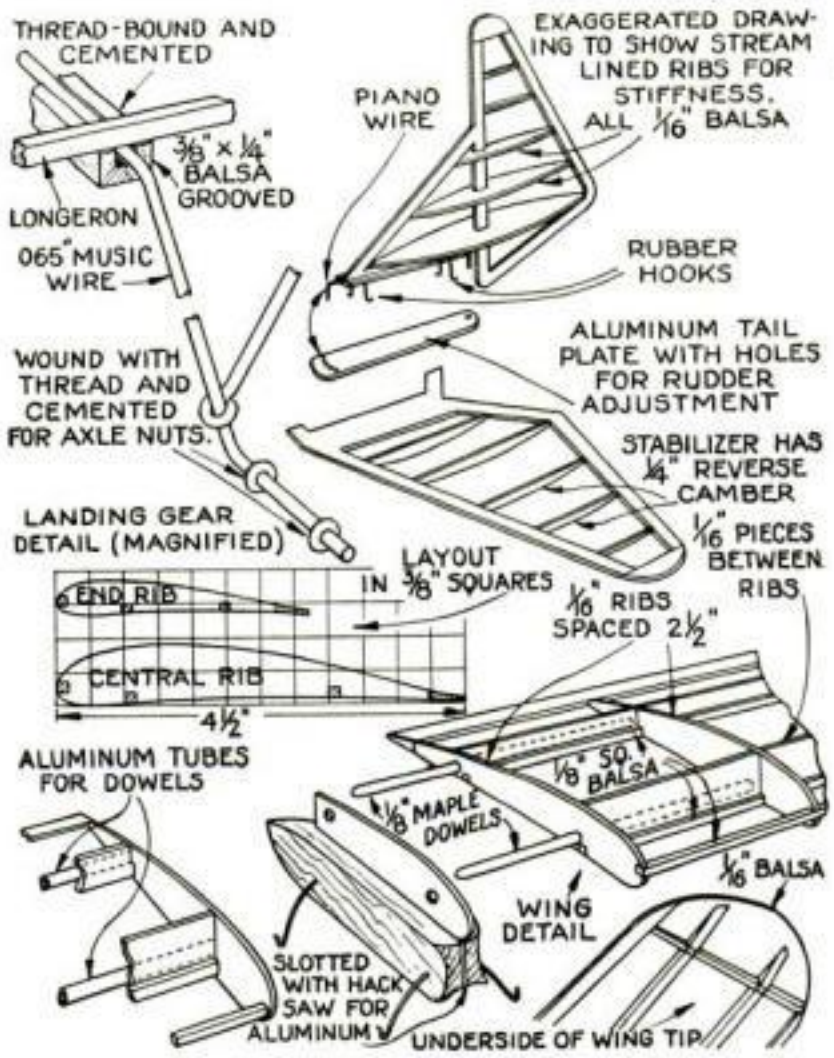
into a long, graceful glide to the earth.

In flying any type of glider, always pick a locality that presents many sources of rising air currents; a rocky valley or a sandy beach is probably the best. The glider then will soar from one rising current to the next, gaining altitude each time it passes over an upward eddy.

To launch the glider, grasp it lightly just back of the wings and thrust it forward with an easy motion of the arm. Do not try to force the glider by launching it with too swift a motion. The hand should serve as little more than a platform for launching.

If the glider does not perform as it should, an adjustment of the wing either backward or forward or of the stabilizer to the right or to the left will probably remedy the trouble.

The model gains altitude quickly, soars on rising air currents, and then glides gracefully.



Construction of the music wire landing gear rudder and stabilizer unit wing and wing tip; and dimensions of the wing ribs.

With the coming of spring and warmer weather, airplane model activities can again be carried on out of doors.

Plans for eight flying models are included in the list of blueprints on page 111. These blueprints contain full size drawings of the planes with all of the necessary dimensions and important details of construction.

An article by Mr. Sibley dealing with the construction of a swift pursuit model is scheduled for early publication.

COMING FEATURES

Hard Soldering and Brazing

How to Make a Hepplewhite Card Table

Testing Brasses and Bronzes

Building a Double Workbench for the Home Workshop

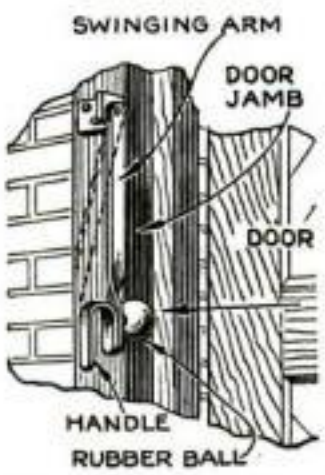
Unique Forms of Trout Flies and How to Make Them

Hanging Curtain Rods Correctly

Making a Hunting Knife from an Old File

Rubber Ball Saves Sliding Door from Slamming

WHEN the easily constructed device shown below is installed on the jamb of a sliding door, it is impossible for anyone to slam the door closed and perhaps ruin the catch and spring jamb.



The ball is fastened to a freely swinging bracket.

The device consists of a small soft rubber ball attached to a steel arm, which in turn is fastened to the jamb of the door in such a way as to rest against the inside of the jamb when the door is open. The arm is pivoted at the wall fastening so that it can be lifted free of the jamb and allow the door to be closed. The gooseneck piece acts as a handle and also serves to keep the ball against the jamb.

If anyone shoves the door shut without first holding the ball away from the jamb, the rubber ball will take the shock and save the catch.—R. H. DAUTERICK.

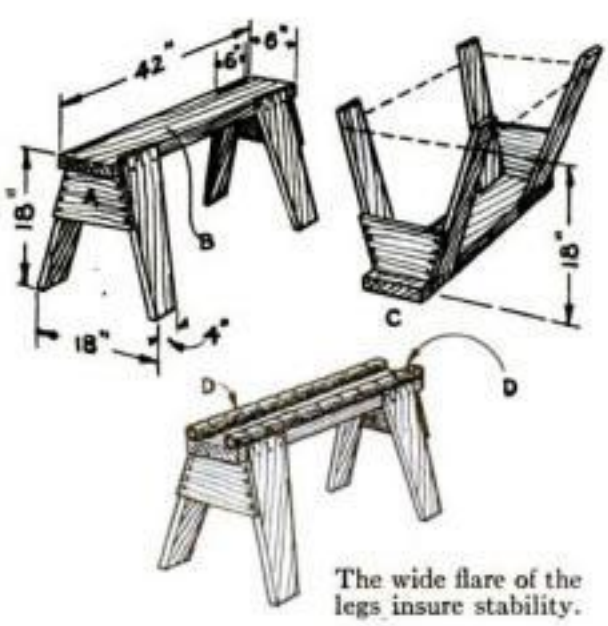
How to Build a Sturdy Sawhorse

STURDY horses for use in supporting work are an indispensable part of the home workshop equipment. Makeshifts are bound to give difficulty in even the simplest of jobs and should therefore be avoided.

The tops (*B*) of the horses shown can be made from spruce, fir, or similar wood.

Cut bevels to receive the eight legs, being sure that they will give the necessary flare to the legs, which must slant outward in such a way as to prevent any possibility of tipping.

The legs, cut from 1-in. stock, are 6 in. wide at the top and 4 in. wide at the bottom. Cut them slightly long and nail them in the recesses chiseled in the top. Fit the legs carefully, being sure to obtain the correct amount of flare. After the legs have been placed, plane the tops of them flush with the top of the horse, then turn the horse upside down as shown at *C* and measure the height of each leg from the floor. In this way any deviation in the flare of the legs will be allowed for automatically.



The wide flare of the legs insure stability.

The two end pieces (*A*) are cut from 1-in. stock and fitted in place after the legs have been attached.

If the horses are to be used in the construction of fine furniture or if finished work is to be rested on these supports, wind thick cloth or felt around pieces of ¾ in. square lumber and brad two of these to the top of each horse as shown in *D*. These also serve as stops when the legs of a chair are rested on the tops of the horses, as in the upholstering of chairs and benches.—C. A. K.

"Take no chances with inferior tubes!"

Says **F. A. D. ANDREA,**
President of **F. A. D. ANDREA, INC.**
"FADA RADIO"

"WE test all our sets with RCA Radiotrons and recommend the use of RCA Radiotrons for Fada Vibra-Control Radio. RCA Radiotron quality and engineering precision assure the maximum performance built into every Fada set. They are the only safeguard against troubles caused by faulty tube construction. Take no chances with inferior vacuum tubes. To get maximum enjoyment from Fada Vibra-Control Radio use long-lived RCA Radiotrons throughout for both initial equipment and yearly replacement."

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Old tubes may impair the performance of the new

RCA RADIOTRON CO., INC., HARRISON, N. J.

RCA Radiotron

THE HEART OF YOUR RADIO SET

Helpful Ideas for the Car Owner

IF ALL roads were level and smooth, the problem of jacking up a front or back wheel to change tires would always be simple. Unfortunately, however, there are many times when the normal safe place for a tire change, off the paved portion of the road, presents unexpected difficulties. There may be a deep rut exactly where the jack should be placed, or the road may slope in such a way that the car is likely to roll off the jack. A pair of wood blocks shaped as shown in Fig. 1 will prove useful in such emergencies. One will serve as a chock for the car on a hill. Two, four, six, or even eight inches can be added to the height of the jack to reach up from a hollow depending on how the blocks are piled. The two blocks bolted together will support the front axle with both wheels off the ground when adjusting, greasing, and so on. For a large car or truck the blocks should measure approximately eight by twelve inches, with the thickness four inches at one end and two inches at the other.

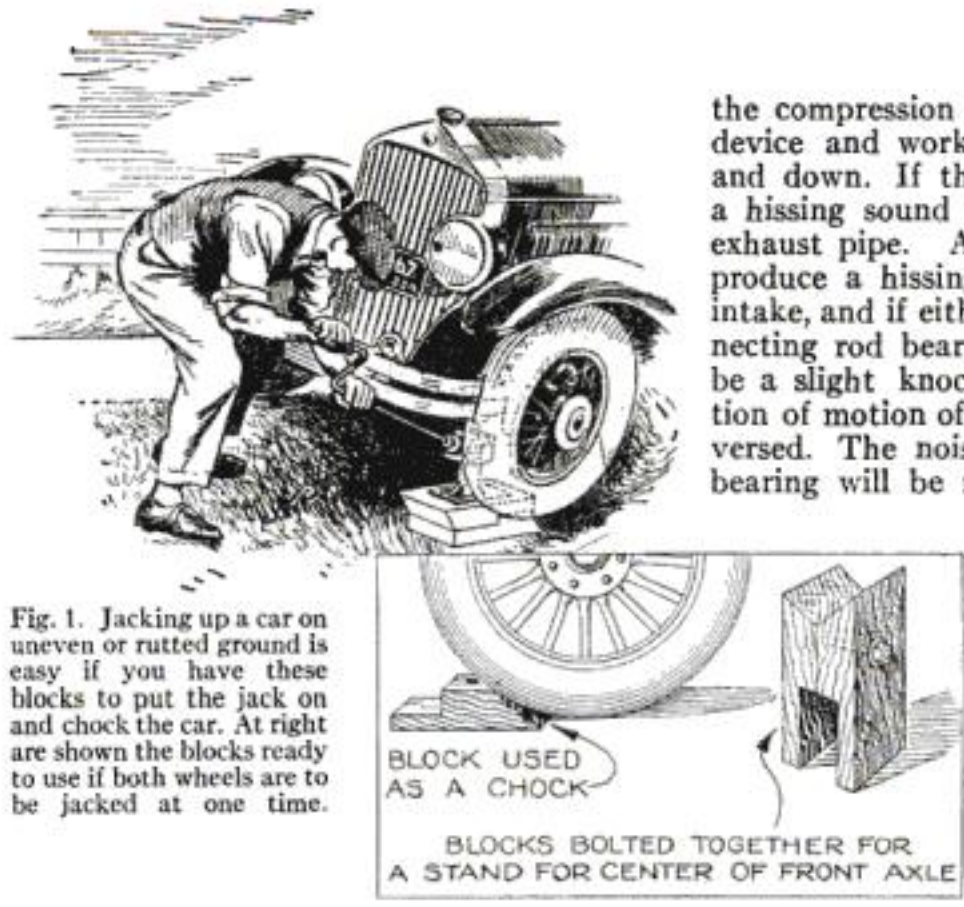


Fig. 1. Jacking up a car on uneven or rutted ground is easy if you have these blocks to put the jack on and chock the car. At right are shown the blocks ready to use if both wheels are to be jacked at one time.

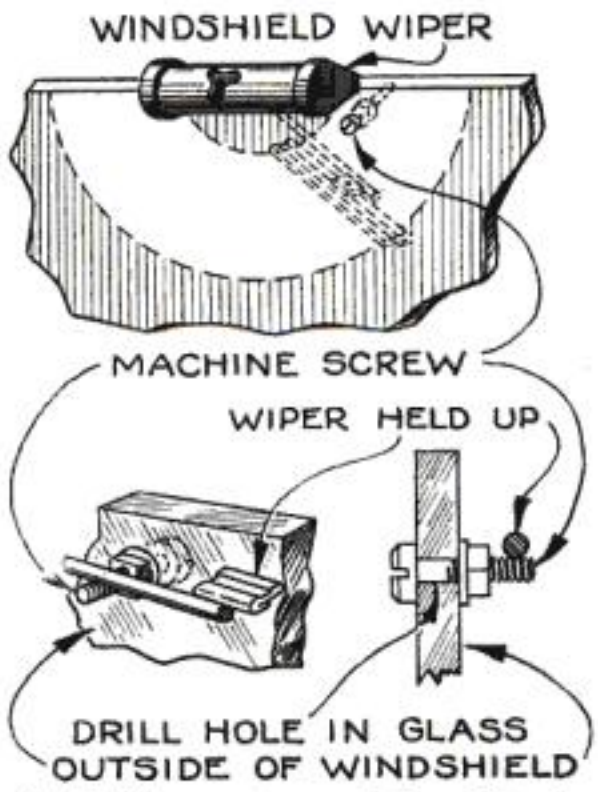


Fig. 2. This suggests a practical way of keeping the windshield wiper out of the line of vision.

Spring Holds Jack

THE ratchet type auto jack always seems to work out to its full length in the tool kit, causing a delay while it is racked back to its telescoped position. Figure 3 shows a way to overcome this trouble. A light spring is attached at one end to the head of the jack and at the other end to the toe.

Wiper Arm Holder

MANY types of windshield wipers cause trouble when not in use by slipping down into the line of vision. A simple and positive wiper holder is shown in Fig. 2. Drill a one-eighth-inch hole through the glass and fit a short screw and nut so that the end of the screw will project just enough to act as a retaining pin. While this arrangement necessitates reaching outside the windshield in closed cars, it is ideal, because of its neat appearance, on sport roadsters.

Pump Tests Loose Bearings

THE shell from a discarded spark plug, a brass nipple, and an old tire pump can be made up into a connecting rod and wrist pin bearing tester as shown in Fig. 4. The nipple should be screwed or soldered into the spark plug shell and into the end of the pump. The plunger of the pump should be removed and fitted with an extra washer in reversed position so that it will be air-tight when moved in either direction.

To use the device, remove the spark plug from one cylinder and turn the crank shaft till the piston is at the top of the compression stroke. Screw in test device and work the pump handle up and down. If the exhaust valves leak, a hissing sound can be heard from the exhaust pipe. A leaky inlet valve will produce a hissing at the carburetor air intake, and if either the wrist pin or connecting rod bearings are loose there will be a slight knock each time the direction of motion of the pump plunger is reversed. The noise produced by a loose bearing will be much more distinct if the test is made while the motor is hot after a trip. A cold motor may not give any loose bearing noise because of the congealed oil.

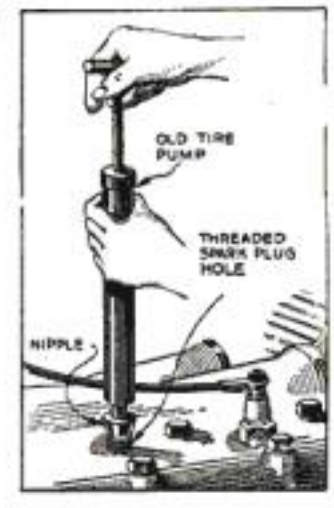


Fig. 3 above; spring keeps auto jack from working out to full length in tool kit. Fig. 4, right, shows homemade device for testing of bearings.

POPULAR SCIENCE MONTHLY awards each month a prize of $10, in addition to regular space rates, for the best idea sent in for motorists. This month's prize goes to Charles H. Willey, West Concord, N. H., for his suggestion for handy jack blocks for use in changing tires (shown in Figure 1, top of page).

Simple Test for Leaks

LEAKS in the cooling system are sometimes only apparent when the engine is operating, and the circulating water is hot. Such leaks are difficult to find and repair. The smallest leak, however, can be detected at once by applying air pressure to the cooling system. This may be done by using part of an old inner tube and a piece of cork. Use the cork to plug the overflow pipe and cut a circle of rubber from the inner tube with the valve at the center. Remove the filler cap and bind the section of the inner tube over the opening as shown in Fig. 5. Pressure is then applied with a tire pump. Only a few strokes are required. Be very careful not to apply too much pressure to avoid damaging the radiator. The radiator of an automobile is not designed to withstand pressure. Too much may open up a seam or bulge out the side of the upper or lower water tanks.

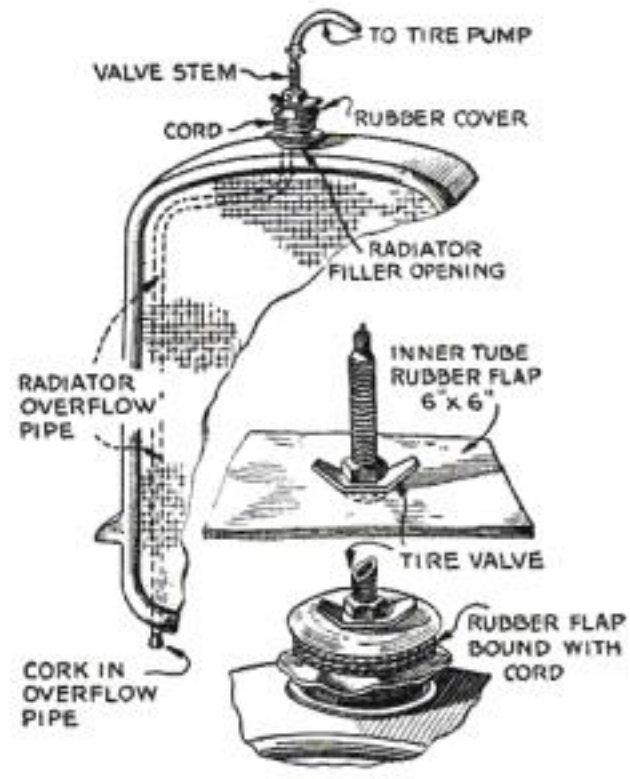
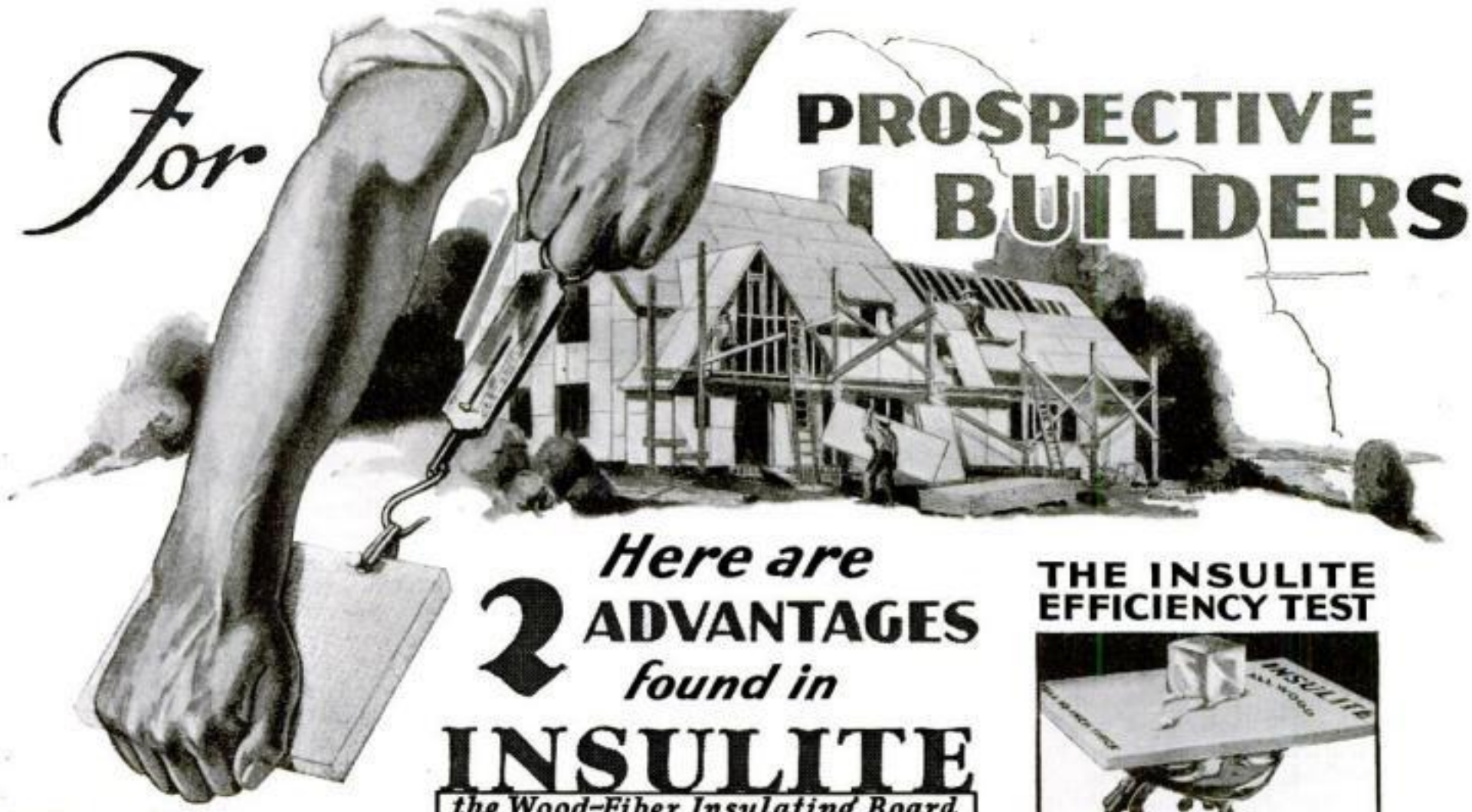


Fig. 5. Leaks in the cooling system are easily found when pressure is applied as shown here.



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Completing Our *Seascoot* Boat

How to Plank and Calk the Sides and Bottom, Build Decks, and Attach the Deck Fittings

By W. F. CROSBY
Editor of *The Rudder*

Trimness, durability, seaworthiness, and ease of construction are features of the *Seascoot*.

WITH the frame erected and the seam battens, chine logs, keel, and other parts in place, our 15½-ft. outboard motor boat *Seascoot* began to look like a real boat. The construction had been carried to the point described in the preceding article (P. S. M., Mar. '30, p. 75), and the frame was ready for the planking.

The lower side planks were prepared, first one side and then the other. Since the seam battens were located so that they subdivided each frame into three sections, the first plank was fitted so that its edge came as exactly as possible to the center of the lower seam batten; that is, the one nearest the chine.

In planking, it is well to remember that most of the bend is toward the bow and therefore it is far wiser to get the bow end fastened in place first and then work toward the stern. If you do not do this, you will find that it is much harder to make the bend; and it may take two or three assistants to hold the plank in place while you put in the last few screws. The way we worked it was to set the plank up in place and clamp it fast after first planing off any rough edges.

In attaching a plank, it was necessary first to determine the bevel at the point where the plank came in contact with the rabbeted stem piece. This was done by holding the plank as close as possible to the stem and marking it with a pencil guided by a short length of straight wood held exactly parallel to the rabbet in the stem. The plank was then taken down, the excess wood sawed off, and the cut end smoothed with a plane.

With the bevel cut, the next step was to have an assistant hold the plank in such a way that the bevel fitted snugly against the rabbet. The plank was not bent but merely held in place, the stern end being far out from the side of the boat. Two or three screws were used in fastening the plank to the stem. Then we started screwing it fast to the chine log. Placing screws every 4 in., we gradually worked toward the stern. After the plank was securely in place, we went back and screwed it to each frame, putting in about three screws between the chine and the first seam batten.

While the corresponding plank on the opposite side was being fitted and fastened, my coworker started to remove the excess wood on the first plank with a draw knife (a big jack plane would serve as well).

Above: Marking the bevel preparatory to cutting and fitting a plank. Right: How the lower plank is clamped prior to fitting.

The second plank was fitted in just the same way as the others, except that it was shaped to come to the center of the second seam batten. First, it was clamped up against the side of the boat, and the bevel cut; then we proceeded to run a pencil inside in such a way that the outline of the edge of the seam batten was transferred to the inside of the plank. The plank was then removed and another line drawn at a distance of one half the width of the seam batten inside of the first. This line was used as a guide for the cut. Both edges were planed to remove any roughness and then the plank was fastened in place.

The third side plank has one edge on the upper seam batten while the other edge forms the sheer. The sheer heights were then laid off on the plank after the lower edge had been fitted to the other plank and the bevel for the stem cut. The excess material was planed off later, when the boat was turned over.

Planing down the lower plank, making it nearly flush with the chine line. The edge must be true with the frames.

We started amidships with the bottom planking and laid a piece of the ¾-in. stock across the boat, squared it with the keel, and then marked it with a pencil to the shape of the side on the underside of the plank. This was done to make the ends conform to the shape of the sides of the boat.

The plank was then taken off and sawed close to the pencil marks. In order to keep the joint (where the bottom planks meet the chine) absolutely tight, we laid cotton threading along the chine piece and daubed it with old paint. The keel also was painted before the planks were put in place in order to prevent rotting. Very heavy screws were then set in the edges of the planks and driven into the chine logs, four being placed in each edge; and three were driven down the center into the keel. Before making the plank fast, however, we made sure that it was square with the keel.

The next plank forward was fitted in the same way, and so on fore-and-aft until the bottom was completed. At

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the bow, however, the plank was put in place with the grain running fore and aft instead of athwartships. This was done to make it stronger at this point and to eliminate the danger of splitting if the boat is ever hauled out on a rocky beach.

At this point we went over the entire boat to see that every screw was set up tight, that none had stripped their threads in the wood and turned loosely, and that the side and bottom planks were securely fastened to the transom.

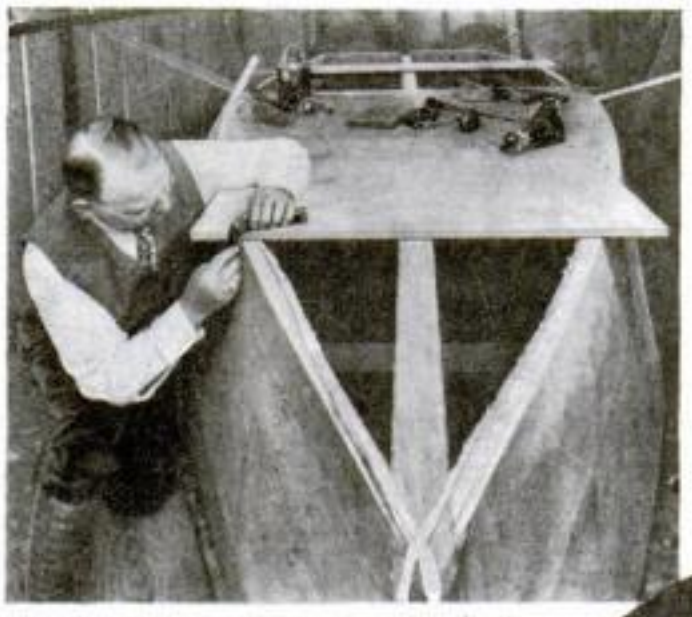
Instead of calking the bottom in the usual way with hammer and calking iron, we found that a small cutting wheel held in a handle was far easier and made considerably less noise. Do not calk the seams too tightly because the planks will swell in the water and in doing so they would force out the compound.

When the calking of the side and bottom seams was completed, each seam was thoroughly covered with a seam composition. This material, especially made for marine use, has the advantage of never hardening the way putty will. It adapts itself to the swelling and shrinking of the planks and does not drop out like putty. The seam composition was permitted to dry on the surface, and the excess material was scraped off. The composition also was smeared over the fastenings in the bottoms and sides.

If, however, you prefer to use a mixture of putty and white lead, each seam and screw head mus. be painted first and the putty applied while the paint is wet. This will make it stick in place a little longer.

It was now time for us to turn the boat right side up. She was placed on strong boxes to keep her off the floor, and the excess wood was planed from the upper plank down to the point where the sheer should be.

In building the upper deck, an arc of a circle was marked on a spare piece of wood, allowing half an inch of crown for every foot of beam. In other words, since the boat has a maximum width of 5 ft., we planned to allow a total crown of 2½ in. This piece was used as a template for the deck beams up forward. Six of them were made and fitted across the boat. Where the cleat was to be, we put in a doubling piece fitted between two of the frames and flush with their tops.



Marking the bevel on a bottom plank, which is then cut and fastened in place.

The calking can be quickly and easily forced into the seams by the use of a small metal disk cutting wheel.

The entire forward deck was covered with scrap material about ½ in. thick, and a deck of the same thickness was also laid along the side. No beams were put under it, as it was supported on the ends of the frames. On the deck we laid a piece of 12-oz. canvas 5 ft. square, after applying aviation glue to the wood. The canvas was tacked to one side, pulled tight, and smoothed out; the edges then were fastened with closely spaced copper tacks about half an inch down on each side of the boat.

Putting the forward coamings in place. Note the completed decks and the deck fittings.

After the canvas has been put in place, it is smoothed carefully with a straight, flat board.

The after end of the forward deck was made V-shape with the pointed end forward. A reënforcing beam was laid under the after edges. A small coaming of ¾-in. stock was then fitted across, cut to a V-joint at the center, and carried down to the other side.

A coaming of the same material was run down each side against the edge of the narrow side deck. It was butted securely against the V-shaped coaming and finished with an "ogee" or reverse curve at the stern. The coaming was fastened by screwing it to the side deck and to the frames. When in place, the coaming projected 2 in. above the side deck and about an equal amount below it.

Be sure that the sheer line is perfectly fair and smooth before you do any of this work, because a bump or hollow spot in the sheer will spoil the appearance of the entire boat.

After putting the seats in place, we removed the crosspieces and put in the round oak molding which runs the entire length of the boat on each side at the sheer line. We also fitted a knee from the keel to the center of the stern piece or transom to hold the engine.

Seascoot was painted a dull gray with buff colored seats and deck. The sides were painted white, and the bottom and water line were painted with the best antifouling red copper paint. The water line was painted with the aid of a piece of twine, which was stretched from bow to stern.

On her forward deck we put two small chocks to take the anchor line, a cleat, and a flagpole socket. Another flagpole socket was placed aft. All of these are of galvanized iron. A small yacht ensign and small oak flagpoles fore and aft completed the picture.

Then came the day of launching. *Seascoot* was carried down the beach and was at last afloat. A small 3½-horsepower outboard engine was clamped to the stern, and in a few minutes she was cutting the water at a speed of about 9 miles an hour. *Seascoot* did not leak a drop—and that's going some for a new boat! We had placed several buckets of water in her before she left the garage, and the moisture had several days to swell up whatever small openings might have been overlooked.

Without a passenger, she drew about 1½ in. of water at the deepest point, minus the engine, of course. She has carried five people easily and is so stable that with two of us on one side, sitting on the coaming, she tipped up only about half an inch. I should not recommend too much power—certainly not more than 16 horsepower—because *Seascoot* is not made for racing purposes.

Since she is under 16 ft. in length, she requires no Government license; however, she must carry an approved life preserver for every person on board, an approved fire extinguisher, two copies of the *Pilot Rules*, which can be obtained from any customs house, and a whistle capable of blowing a blast of at least two seconds' duration (a mouth whistle will pass). Lights for a boat of this type consist of a red and green bow light and a white light at the stern, visible in all directions and higher than the bow lights.

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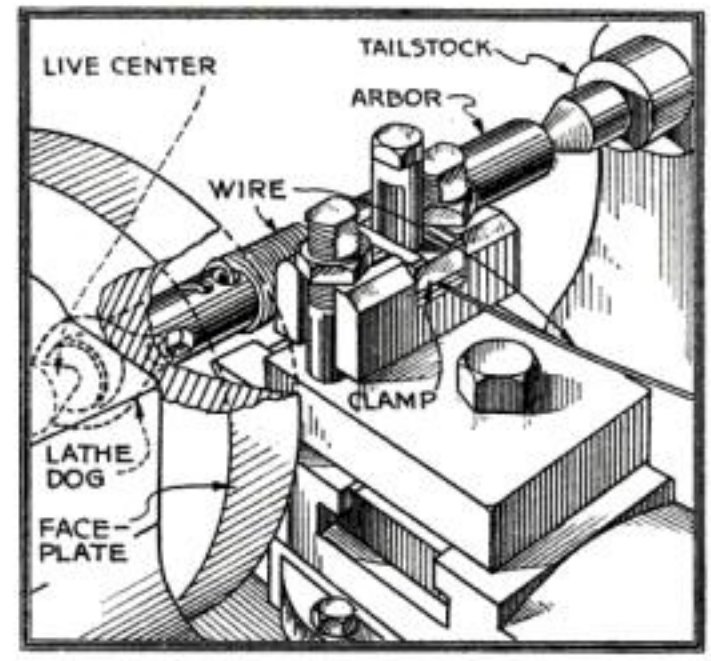
More Ways to Put Wire to Work

By HENRY SIMON



Complete details of this coil-spring winding device for use in a lathe are given in Fig. 6 on page 94.

SO MANY are the uses of wire that every mechanic, amateur or professional, needs to know how to handle it expertly. And, strange to say, there are more "kinks" in using wire than anyone is likely to think—save, perhaps, the apprentice who carelessly snips apart a tightly wound coil of music wire and discovers all at once what a lot he has to learn

A number of suggestions for manipulating wire and applying it to work of various types, together with designs for a cutting machine and a winding tool for use in the lathe, are given in this article. These suggestions supplement the twenty-five hints on wire previously published (P. S. M., Mar. '30, p. 90).

A small, tightly wound spring of the door spring type has a limited use as a belt for transmitting motion as in Fig. 1, although it is unsuitable for a regular drive. Sometimes it can be used to advantage where a light though definite tension must be maintained as at *B*, or where the distance between two pulleys is periodically varied, as at *C*. Other points of usefulness are its indestructibility, its capacity to stand heat up to 500° F., at which temperature ordinary belting would immediately burn up, and its ability to work efficiently in oil and in hot and even boiling liquids, as at *D*. A sheave type pulley having a section like that shown at *E* is best for such a belt.

The mechanical draftsman rarely thinks of wire as a possible help to him, but even he can put it to work on his board. Soft or half-hard wire, bent to any flat shape, may be used for an odd-form template as shown at *A* in Fig. 2. A similar end is served by the combination of hollow wire and piano wire, mentioned last month for other purposes, and arranged as at *B*, to make a flexible rule for the drawing of curves. Though such a rule does not automatically lie flat, it has the advantage of being quite inexpensive and practically unbreakable. And very fine, soft wire used in connection with pins of fairly large diameter placed at the foci, is superior to string for drawing ellipses of large size as shown at *C*, because it has practically no "give."

NAVAL gun construction has a lesson to teach the experimenter by reminding him how wire can be employed for producing the strongest possible tube or cylinder of a given weight and size. This is done by sandwiching one or more wire windings between two steel shells, as at *A*, Fig. 3. One way of producing such a combination shell is by making the wire winding in the form of a close-wound, tight-fitting coil spring, "screwing" this spring on the part by turning it opposite to the direction of the winding, as at *B*, and then shrinking the outer shell on, as at *C*. In working with high-pressure gas, hydraulic, or other expansive pressures, such a construction may be useful because it combines safety and light weight and requires little space.

There are a few simple tricks in handling wire that it pays to use—none better than the simple "safety first" kink shown in Fig. 4 at *A*. This is the practice of bending the end of any spring wire back upon itself in a loop after every handling or when cutting off long pieces. Heavy piano wire, done up in the overwound small coils in which it is commonly sold, is a dangerous thing, and this simple precaution will save many injuries.

Another aid in taming this sometimes uncontrollable product is the wooden coil cage shown at *B*. The whole coil, tied as it comes, is placed on a wooden hub, and a bar is then put in place to retain the wire. It may be observed that neither this nor any other expedient will ever make it satisfactory to handle spring wire put up in the tight rolls in which small quantities are sold. At *C* is shown a wall hook suitable for hanging soft and half-hard wire. It is more satisfactory than the ordinary hook because of its added length, as indicated at *D*.

The machine shop mechanic has little need for the splicing of wire, but frequent occasion for bending, winding, and cutting it. Cutting wire to length with pliers is tiresome when a large number of pieces must be so obtained. A simple cutting device that cuts and gages any size wire and can be used in either a vise or under a press is shown in Fig. 5 at *A*, *B*, and *C*. The interchangeable bushings can be readily made to fit any size wire, and are easily reground and reset, as is also the cutter slide which is shown in detail at *D* in Fig. 5.

Wire forming is a complicated art and science in itself, but a suggestion of a simple rigging for bending limited numbers of duplicate pieces is given at *E*, Fig. 5. The pins should be no longer than necessary and well rounded on top to prevent any possible injury to the fingers. As indicated at *F*, the same plate can be used for numerous parts of different shapes.

SEVERAL effective hand tools exist for winding wire, and usually these suffice for ordinary shop purposes. Where higher accuracy is required or where many coils must be wound, a more mechanical way of winding sometimes becomes advisable. A lathe tool for this purpose is shown at the top of the page and in Fig. 6 at *A*. It consists of a base block *a*, which is mounted on the compound rest, and a wire-feeding float *b* capable of a limited movement parallel to the lathe spindle axis. Nuts *c* acting against a spring *d* allow the float body to be adjusted to various heights to suit the spring diameter being wound. With this device, springs of tight tension can be wound practically without regard to the feed; or coils may be spaced the exact feed distance apart by locking the float against blocks placed underneath it. With spring wire, it is useful to remember that the diameter of the coil spring can be changed with the same arbor by varying the sliding

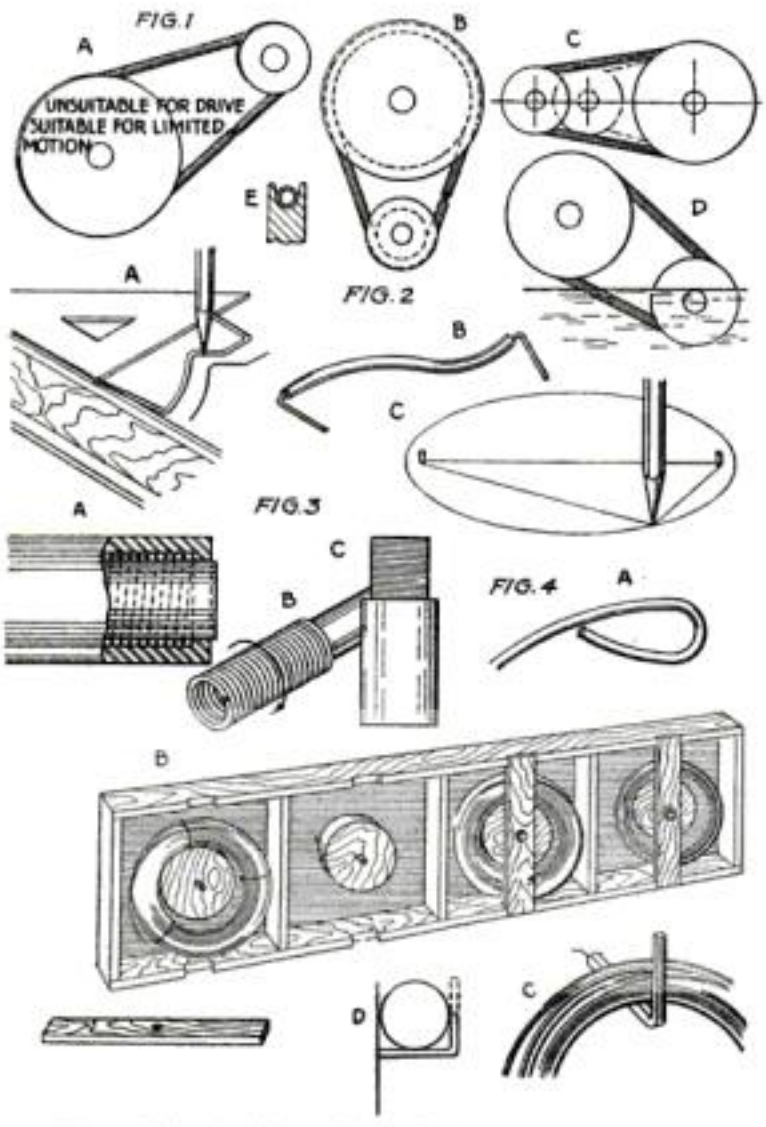


Fig. 1. Coil wire drives. Fig. 2. Wire as an aid to draftsmen. Fig. 3. A strong cylinder. Fig. 4. Hints on handling wire.

friction and thus altering the tension of the wire.

Something that rarely becomes necessary in the average shop is the reduction of wire by drawing. Nevertheless, it is useful to know how it can be done, and Fig. 7 at *A* shows how to do it. The die should be made of high-carbon tool steel, and the taper hole through it should be left from .0005 to .001 in. small for lapping. Fine wire can be readily reduced by a few ten thousandths by pulling it through the die by hand as at *B*, the end having first been tapered down to pass through the die. Redrawing is particularly useful in bringing hollow wire to the exact size, because this wire ordinarily runs to limits of plus or minus .002 in. By drawing, it can be held within limits of plus or minus .00025 in. and even less. The incoming end of the wire should be kept well greased. Do not attempt to reduce wire by more than about 5 or 10 percent at one drawing, and less will be necessary if any great amount of accuracy is essential.

Almost all of the uses to which wire can be put require that the wire be bent; and unless the mechanic has some knowledge of the bending limits of the wire that he is using, he will encounter difficulties. A list of the approximate bending radii for various tempers was given in the preceding article on this same subject (P.S.M., Mar. '30, p. 90). This article also contained hints on casehardening wire and a table of the duration required in the process of casehardening, strengths of wire, forms of sockets for use in connecting wire to machine parts, the uses of wire for machine drives, the use of wire as a reënforcing agent, and the use of wire for the transmission of a push or a pull.

While these two articles do not cover the entire subject of wire handling, they will give the mechanic and the home worker a sound working knowledge of wire as an aid in the solution of shop problems.

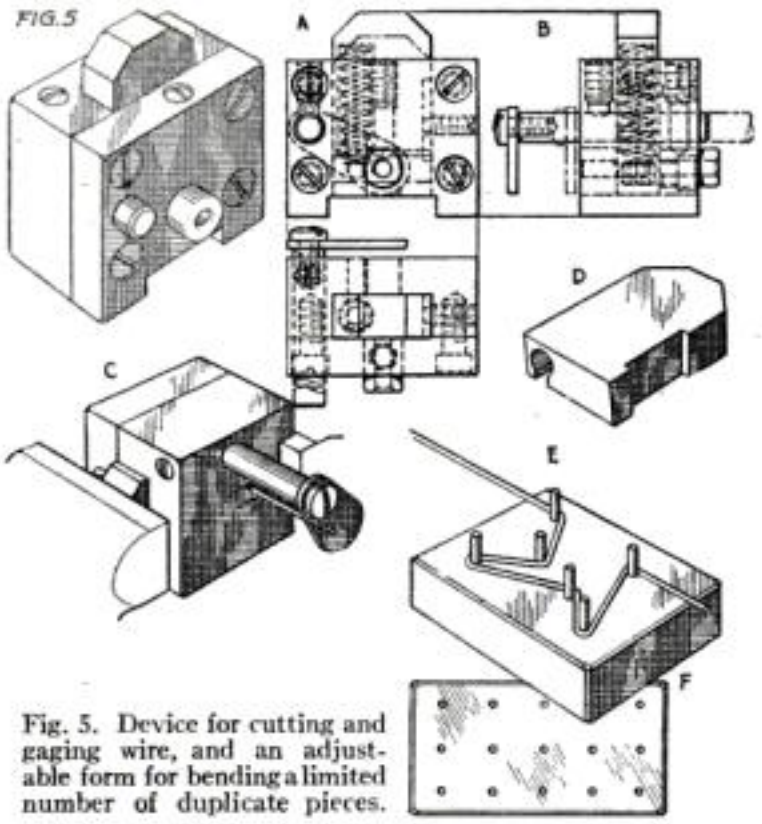


Fig. 5. Device for cutting and gaging wire, and an adjustable form for bending a limited number of duplicate pieces.

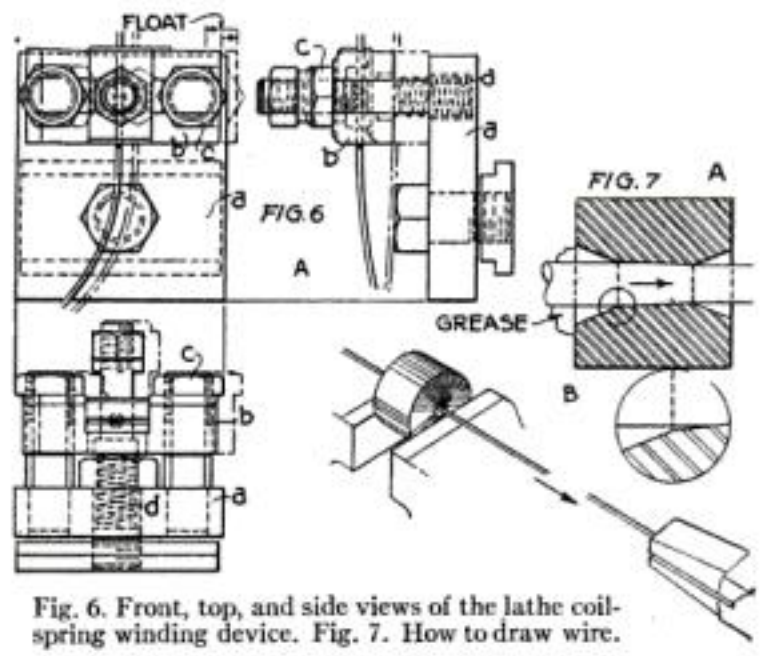


Fig. 6. Front, top, and side views of the lathe coil-spring winding device. Fig. 7. How to draw wire.

Articles dealing with thread cutting and the uses of sheet metal, both of which are by Mr. Simon, are scheduled for early publication.

An intensely practical discussion of boring problems in the jobbing shop has been prepared by Hector Chamberland, and the first installment is to appear in the May issue.

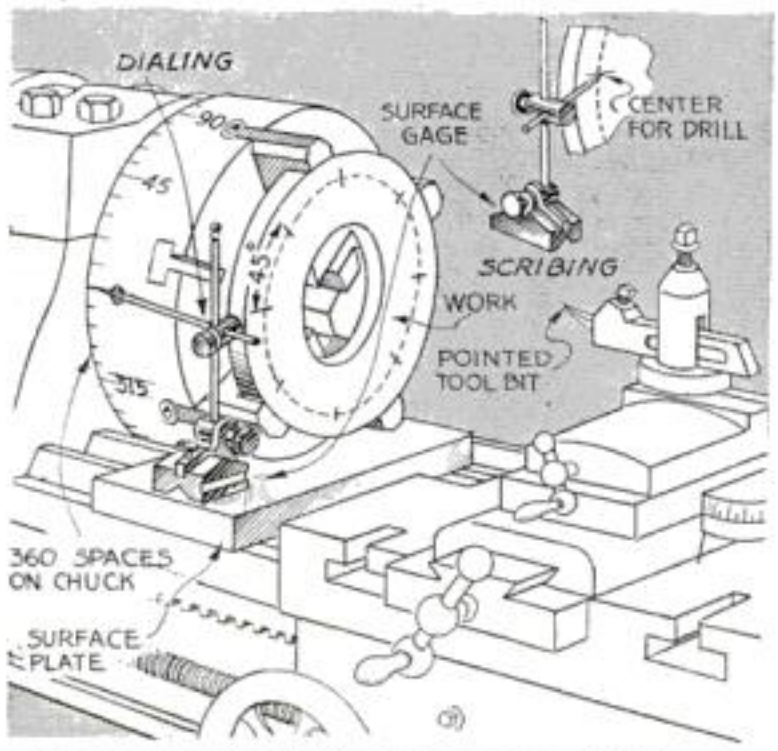
Dividing Work in the Lathe

WORK being machined in the lathe can be laid out for drilling equally spaced holes by the method illustrated. A surface gage and plate and a prepared three- or four-jawed chuck are the means employed.

The chuck must be machined true on its outer cylindrical surface and then divided into 360 equal parts. This can best be done by placing the chuck on an arbor, machining it in the lathe, and then placing it on the dividing head of the milling machine.

The work itself is placed in the chuck and machined as necessary up to the stage when the hole centers are to be laid out. Then the circle for the centers is cut lightly on the surface by means of a pointed tool.

To ascertain the correct spacing, place the surface gage on a steel plate and set the scriber to the center line of the lathe. Move it to the side of the chuck as shown in the operation marked "dialing," set the chuck at zero, and then bring the gage around to the front of the work and scribe a line, as shown under the heading "scribing." Where this mark intersects the circular center line first drawn is the location for the first hole. Repeat this spacing process, moving the chuck through the number of degrees desired. In this way it is possible to mark the centers for holes quickly and accurately while the work is still in the lathe and thus eliminate the necessity of placing the stock in the dividing head of the milling machine before it is taken to the drill press to be drilled.—GEORGE A. MCCULLEY.



The arrangement of the surface gage and plate, and the two steps in the process of spacing the holes.

Old Bill Says—

TO GRIND aluminum or its alloys cylindrically, use kerosene and water if no grinding compound is available.

Educate yourself to safety habits; it will be profitable to you and to all those who work with you.

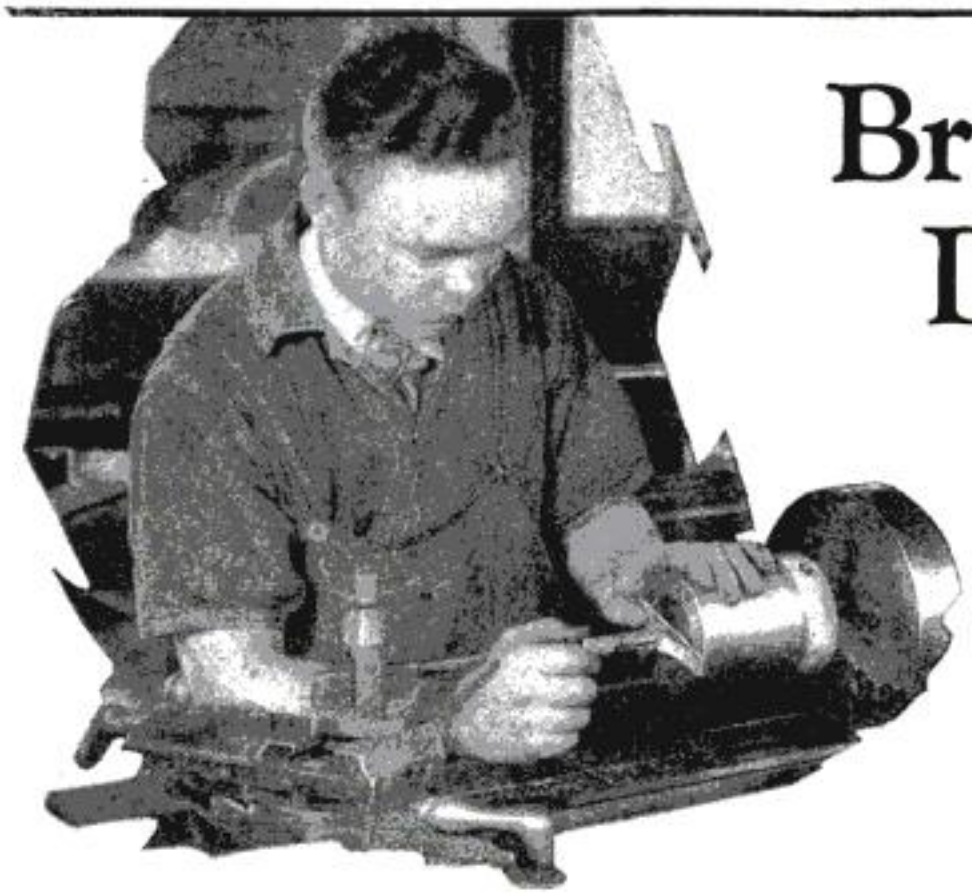
To give a tool made of stellite a high finish, dry-grind the last .0005 in.

A little practice each day in left-hand filing will make the operation much safer for lathe work.

Observe the back and forth movement of a power hack saw and apply the same principle to your hand hack saw.

See that the pilot of your center drill does not get too short and you will rid yourself of the source of many errors.

A good machinist never loosens a tight screw with a prick punch.



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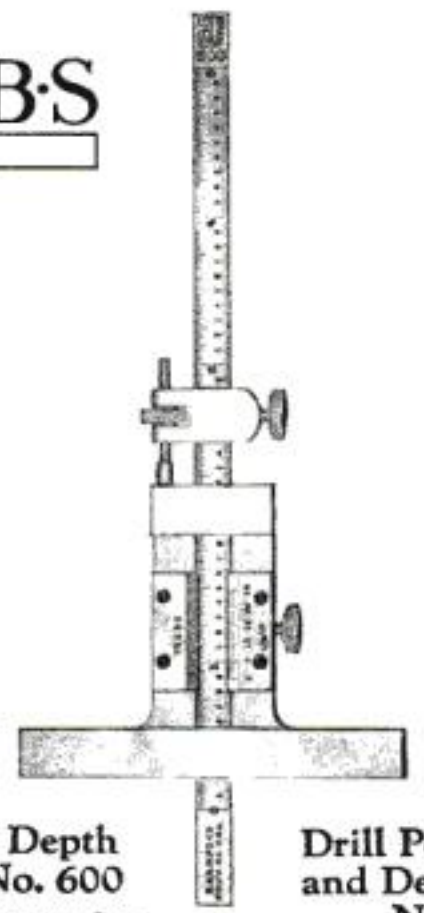
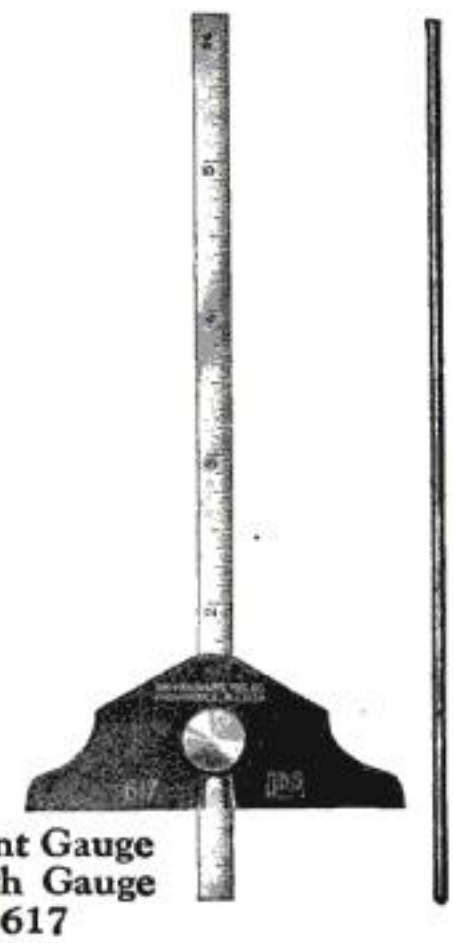
Rod Depth Gauge No. 614

Range 0 to 3″. Depth of hole is read from the graduations on the body of the gauge. The small diameter of the rod permits its use in small holes.



Vernier Depth Gauge No. 600

Graduated to read in 64ths on one edge and by means of a Vernier, in thousandths of an inch on the other. Furnished with 6″ or 12″ blades.



Drill Point Gauge and Depth Gauge No. 617

Range 0 to 5″. No. 617 can be used for checking angles of drill points when grinding them and determines whether the point is central, or it may be used as a depth gauge. Furnished with 6″ rule and 6″ rod.

The full line of Depth Gauges is described in our Small Tool Catalog No. 31. Send for a copy. Dept. P. S., Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.

Brown & Sharpe Tools

"WORLD'S STANDARD OF ACCURACY"

Magazine-Rack End Table

By

W. CLYDE LAMMEY

The bookshelves will hold more than thirty volumes, while the magazine racks provide space for periodicals.

USEFULNESS in the sense that it supplies ample room for books and current magazines is one of the outstanding features of the end table illustrated.

For its construction the following is needed: 1 piece of 13/16 by 14 by 24 in. 5-ply walnut veneer, 1 piece of 3/8 by 24 by 48 in. 3-ply walnut veneer, 2 pieces 1/2 by 10 by 20 in. red gum, 1 piece 13/16 by 4 by 20 in. red gum, and 2 pieces 13/16 by 12 by 28 in. red gum. All this material may be ordered from the mill cut to size and dressed, if desired.

Cut the two 13/16-in. gumwood end pieces to the exact length indicated and joint (plane) the edges true. Lay out the separate designs of the scrollwork on pieces of cardboard and, using them as templates, transfer the designs to the wood. Saw to the outline with either band saw or scroll saw. Sand the edges of the scrollwork thoroughly, making sure that all traces of the saw marks are removed.

Lay out the shape of the top on the piece of walnut plywood and carefully saw to shape with scroll or band saw. Joint the edges true with a jointer plane and sand the rounded corners.

The bookracks are made by cutting two pieces of 1/2-in. stock to size and beveling the top edge of each at an angle of 45 degrees where indicated. Rip the narrow strips left from the original wide pieces each to 2 in. wide and use as the rails.

Fit the ends to the top by placing the inner edge of the upright 2 3/16 in. in from the outer edge of the top, and fasten with glue and screws.

Cut two triangular bookrack blocks from 13/16-in. stock and fasten one in place in the center of each upright end piece.

Set the bookshelves in place over the blocks; and when the beveled edges at the top fit snugly, nail the shelves in place with several small finishing nails, sinking the heads with the nail set.

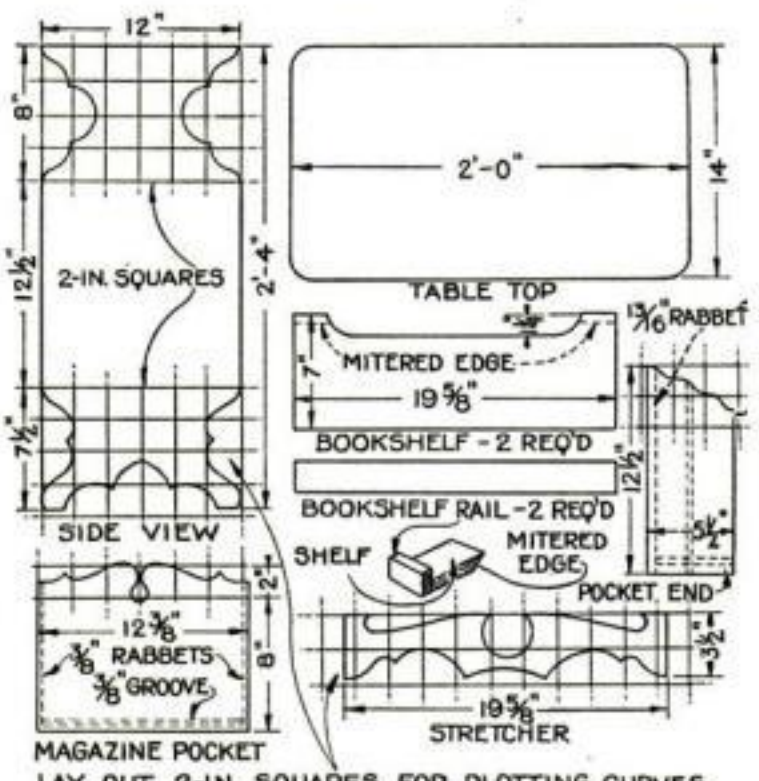
Cut all pieces for the racks from 3/8-in. plywood to the dimensions shown. Run all rabbets to a depth of 1/8 in. Lay out the scrollwork with a paper template as before and cut the upper edges to shape. Rabbets in the pocket ends fit over the edges of the end supports of the table. The two centerpieces for the pockets are trimmed to fit after the pockets are assembled. They are not glued in their grooves but are left loose for cleaning.

Saw out the piece for the ornamental stretcher from the 13/16-in. gumwood, sand the edges of the scrollwork smooth, and nail and glue in place.

Clean up the entire surface with fine sandpaper and stain the gumwood parts with a walnut oil stain, wiping the stain lightly so that it dries evenly and matches the walnut plywood.

Next, fill all of the walnut surfaces with walnut paste filler, taking special pains with the nail holes. Using No. 8–0 wet-or-dry sandpaper and either linseed or rubbing oil, rub all parts to a smooth surface. Clean with a cloth and turpentine and then give the entire table two coats of high-grade varnish.

When dry, rub to a dull satin finish with powdered rottenstone and oil, clean off, and polish with a soft, dry, lintless cloth.



Dimensions of the end pieces, magazine pockets, top, and other parts. Note the construction of the bookshelves, magazine compartments, and curved stretcher.

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You can see this exclusive construction inside an Eveready Raytheon. Look at the diagram on this page. See the solid, four-cornered glass stem. Notice, imbedded in it, the four sturdy pillars supporting the elements. That shows why Eveready Raytheons are stronger than ordinary tubes—and why they give you the best reception you can possibly get from your present receiver. No other tube can be made like this, because the 4-*Pillar construction* is patented.

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EVEREADY RAYTHEON SCREEN GRID TUBE, ER 224. *The weight of the four large elements in this type of tube makes the exclusive Eveready Raytheon* 4-Pillar construction *vitally important.*

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This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

How to Make an Embossed Leather Trinket Box

By F. CLARKE HUGHES

FEW tools are needed in the construction of the attractively embossed sole leather trinket box shown. The leather can be quickly cut to shape with a sharp knife, and the embossing process is accomplished through the use of simple wire forms which are pressed into the surface of the leather.

While the drawings show the dimensions for a box 2¼ in. square, they may be varied if it is kept in mind that the top must be large enough to fit over the main body of the box. A good rule to follow is to make the outside of the lid about three times the thickness of the leather larger than the outside of the box itself.

It is well in constructing a box of this sort to make a cardboard model by cutting pieces as required and folding them to shape. The patterns thus obtained can be used in cutting the leather to the exact shapes.

After the two parts of the box have been cut out, the holes for the lacing can be punched and the edges mitered to allow folding. The holes in the lid should be about 1/16 in. in diameter, while those in the body of the box need be only large enough to receive a medium size sewing needle. The holes can be punched with either a regular leather punch or with a nail filed flat and used on the end grain of a block of wood as in a sketch below.

The leather box forms a neat container for odd buttons and small sewing accessories.

The embossing is accomplished by the use of wire bent to the desired design as illustrated. These forms can be made of either square or round stock. Two forms can be made and the embossing process repeated until the four faces and top are embossed; or five frames, four for the sides and one for the top, can be made and the entire process completed with one pressing.

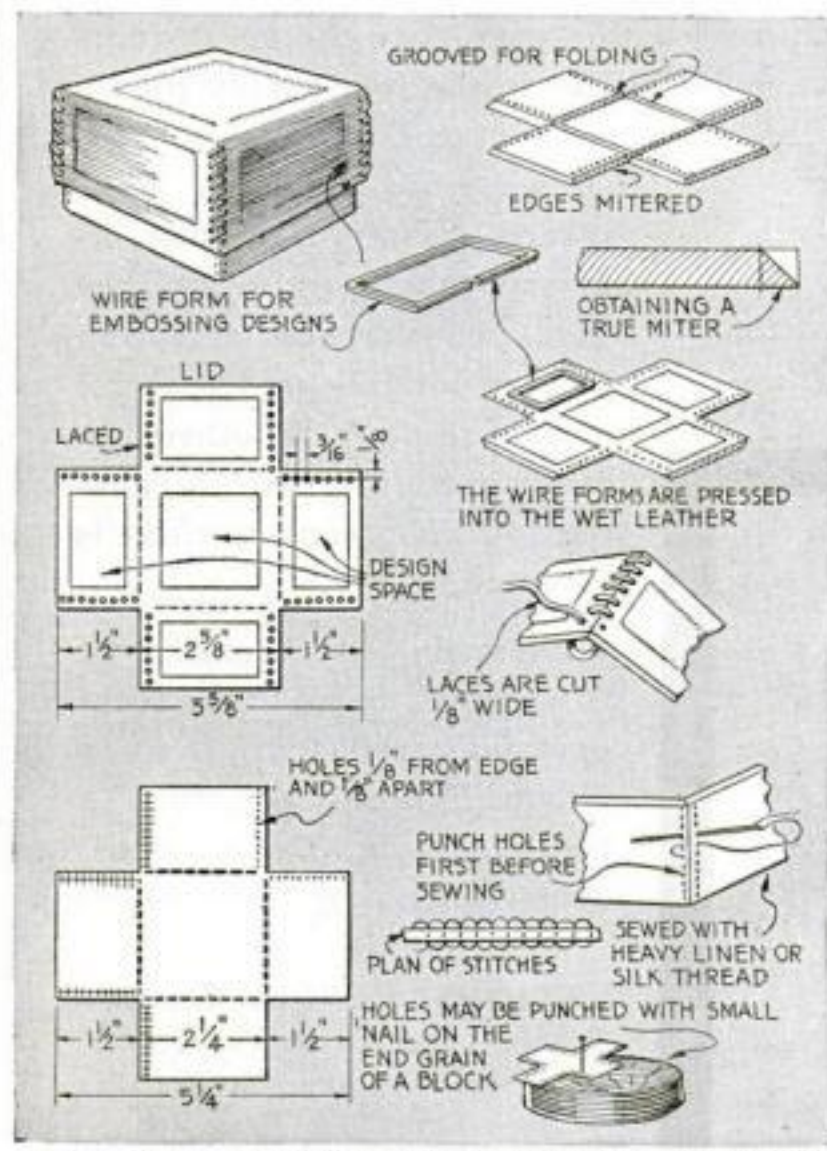
Wet the leather, place the wire forms, and insert the leather, forms, felt pads, and blocks into a vise or old letterpress and apply the pressure (P.S.M., Feb. '30, p. 96).

After the lid has been embossed, wet the leather along the lines of the corners and bend the parts to shape.

The lacing, which can be of any leather—kangaroo or wallaby skin, however, being preferred—should be cut about ⅛ in. wide and laced in the holes in the manner illustrated.

If desired, the inside of the box can be lined with kid, lining leather, or ordinary felt by cutting the material to the shape chosen for the main part of the box and carefully gluing it in place.

After the box has been assembled and laced, the entire outer surface should be polished thoroughly with ordinary wax or shoe dressing.



The dimensions are principally to indicate the proportions; the box can be made any size desired. Note the method of stitching.

This is the sixth of a series of articles by Mr. Hughes dealing with applications of this new, easy, and efficient method of embossing leather. A handsome leather book cover is his next project.

FOR A MAN WITH SPORTING BLOOD

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Builds Home in Spare Time

Reader constructs large five-room bungalow for $2,500 including price of the lot, and incorporates a number of conveniences together with a built-in garage.

The front of the house showing the brick terrace and semicircular concrete porch.

The built-in garage is entered from the rear of the house by means of a ramp.

BUILDING bit by bit during his spare time, R. J. Stephens, of Kansas City, Mo., constructed the remarkable five-room bungalow illustrated. It is thoroughly modern, even to a built-in garage, and its materials are of the best quality throughout, yet the cost for the house and a 50 by 142 ft. lot, exclusive of Mr. Stephens' labor, was only $2,500, every item having been recorded.

But can other readers approach this feat? Mr. Stephens believes they can.

"It seems to me," is his modest comment, "that what I have accomplished should be an inspiration to anyone with a little capital and a little credit and a whole lot of stick-to-it-ive-ness."

Nevertheless, the many curious visitors who inspect the house and all his friends wonder how it is that he could have acted as carpenter, designer, bricklayer, concrete worker, painter, decorator, paper hanger, electrician, plumber, draftsman, and tile setter. About the only thing he did not try was the plastering. The surprising fact is that he has never earned wages at any of these trades; he is the secretary and treasurer of a confectioners' equipment company.

A spacious living room and the built-in garage are not the only features of this dwelling. In designing the house, Mr. Stephens' first thought was for a convenient, sensible plan. He was not satisfied with the commonplace plans he found in books and catalogues, so, with the help of Mrs. Stephens, he laid out a floor plan that would give each room ample sunlight and ventilation.

Both the kitchen and the bathroom are placed to give the utmost privacy. The kitchen is especially easy to air, because in addition to a window and a door leading to a large back porch, it is provided with a ceiling ventilator. The free use of arches insures better ventilation of other rooms and gives an appearance of spaciousness which many small houses lack.

The designer-builder and his wife, who helped him in many of the problems relating to the planning.

The built-in garage has a door leading into the basement. This allows Mr. Stephens to go right from his warm house into an equally warm car that will start at the first touch of the starter button even on the coldest mornings.

The garage is 8 ft. wide and nearly 18 ft. long. It has a 7-ft. ceiling, the doors being 4 by 7 ft., a standard size. The interior is lined with heavy fireproof plaster wall board, which meets with the requirements of the local building code. In localities where all masonry construction is required for built-in garages, it would be necessary to use brick, concrete blocks, asbestos blocks, or whatever the code specifies.

The ramp leading to the garage rises 1 ft. for every 4½ ft. in horizontal length, and is 18 ft. long. As it approaches the doors, the driveway is nearly level; in fact, it rises slightly from the outside drain to the doors. This part of the drive is slightly lower than the garage floor so that the doors can fit tightly against the vertical face of the concrete and still allows ample clearance for them to swing clear over the level portion of the drive.

Ample drainage for the ramp and garage was obtained by having one drain inside the garage and one on the level part

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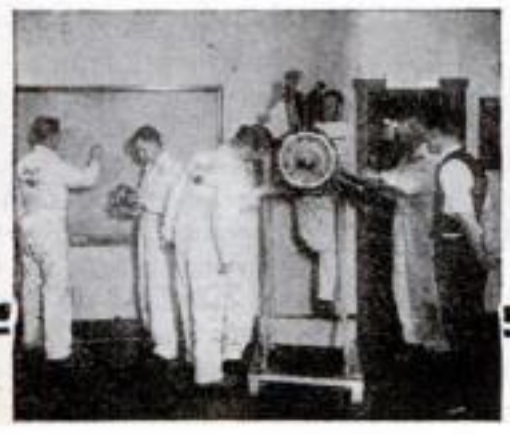

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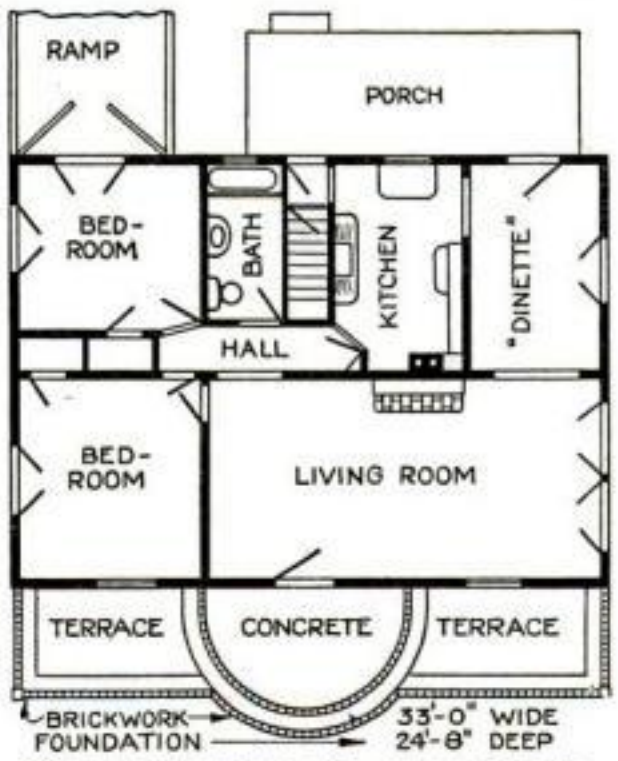


The large living room, with archways leading to hall and "dinette," is a feature of the plan.

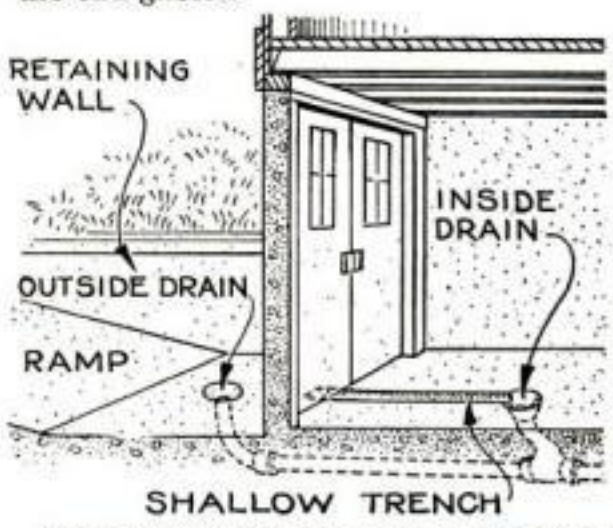
of the ramp (see illustration at right).

Drainage is most important in constructing a basement garage of this type. There is the possibility, even with the construction shown, of finding the doors ice-locked, but not if one is careful. The outside drain should always be kept open; do not depend wholly on the inside drain. Before ice will cake in front of the doors, there must be snow or water, therefore do not allow any snow or water to accumulate.

As an extra precaution, it is well to have a small trench about 3 in. deep right in the concrete floor of the garage leading from the drive under the doors to the inside drain. Then, if the outer drain is frozen up, the surface water formed when the ice thaws on top will pass through this trench to the inner drain. This is important, for if the outer drain is once frozen up, it will be the last to thaw out; and if there came a succession of thawings and freezings, it would not take long to have thick ice in front of the garage doors.

The terrace in the front of the house rests on a heavy subfoundation, which in turn is anchored to the main house foundation by means of steel reënforcing rods. The large concrete semicircular porch rests on I-beams which also are securely anchored. The terrace is faced with tapestry brick set vertically and is so reënforced and bound to the concrete that it has not been affected by frosts.

Many economical kinks were used in the construction of the house. For instance, the heavy brackets which serve to support the gable over the front door were made from scraps left over in cutting the end gables.



Cutaway view of entrance to the basement garage, showing method of draining off the water.

Varnish Sticks Cloth to Desk Top

IF A cheap, thick, quick-drying resinous varnish is used as an adhesive, a desk or table top can be re-covered easily with cloth or, for that matter, genuine or imitation leather. What is known as patching varnish will answer quite as well, but a cheaper and thicker varnish is still better.

Suitable cloth or leather may be had at many different shops. Felted cloths in colors are made for this purpose. Billiard cloth is excellent, provided the green color is satisfactory. Cut the cloth with plenty of overlap on all sides. Then roll it the narrow way, face in, and lay it aside temporarily.

Spread the varnish thickly but smoothly on the desk or table top and see that the edges and corners are well covered. The varnish, when ready to receive the cloth, should be so tacky that it will stick to your fingers when you touch it. Let it stand until very tacky and watch it so as to catch it at just the right moment. As a preliminary test, it is well to spread a little of it on a board and time it; then you will know just how much time to allow.

Unroll the cloth over the varnish and smooth it with a roller, if you have one, without pulling or stretching it in the least. See that the edges are firmly pressed down with a block.

When the varnish on the desk or table top is tacky, the cloth is rolled in place and trimmed.

Lay a thin-edged rule on each waste edge, exactly on the line, and trim it with the point of a very thin, keen knife blade. Hold the knife at a fairly low angle in order to make a slicing cut. Press down the edges with a block and watch it for a while to make sure the edges will stick.

If your varnish was sufficiently tacky and your trimming good, you will have a fine looking top; and the cover will never annoy you by coming loose and rolling up into dog ears at the corners. Be sure, however, to allow the varnish to reach its maximum degree of tackiness before applying the cloth or leather to the top of the table.—HENRY GEORGE.

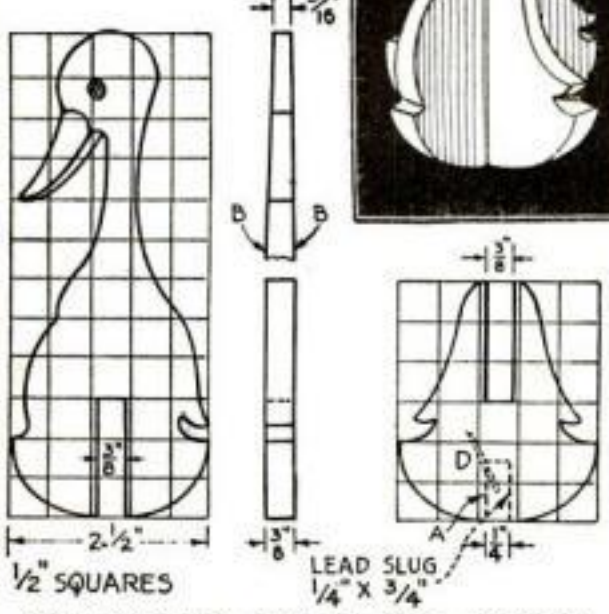
Making a Balancing Gander of Wood

THE steadfast man is a well-balanced man—and the same is true of this gander! Its steadfastness, however, depends upon the weight of a lead slug.

For making the gander, one piece of pine or whitewood ⅜ by 2½ by 6 in. and one piece ⅜ by 2½ by 3 in. are required. Draw ½-in. squares on each as shown and reproduce the curves. Lay out carefully and cut accurately the notches that form the joint, which must fit well but not so closely that either piece will be split.

Saw the curves, plane the taper from the shoulders *BB* to the top of the head as indicated, and smooth the edges with a file and sandpaper. The broad surfaces should be sanded smooth and the joint lightly glued together or held with a brad as indicated at *C*.

Drill a ¼-in. hole ¾ in. deep as at *A*, drive a brad in it as at *D*, and pour melted lead into the hole; the brad *D* will hold the lead in place. Paint the gander in brilliant colors.—CHARLES A. KING.



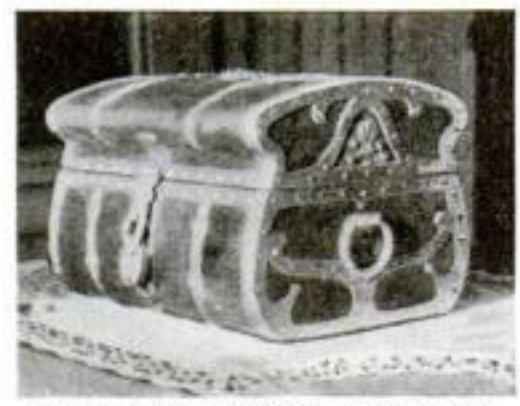
The cuts which form the joints should be made accurately to insure a perfectly tight fit.

Where to Look for Other Mechanical Articles

MANY short articles of interest to mechanically minded men are scattered through the magazine in the sections preceding the Home Workshop Department. If you happen to have missed any of the following, it will pay you to turn back to the pages noted and read them.

Miniature Pirate's Chest Built to Hold Jewelry

By WILLIAM C. CLARK



Jewel casket of black walnut with handmade brass straps and hardware.

ALTHOUGH I designed this antique looking brass-bound chest as a small filing cabinet to match a desk set I had made, my wife decided it would be much more appropriate as a jewel case. So today my filing box graces her dressing table.

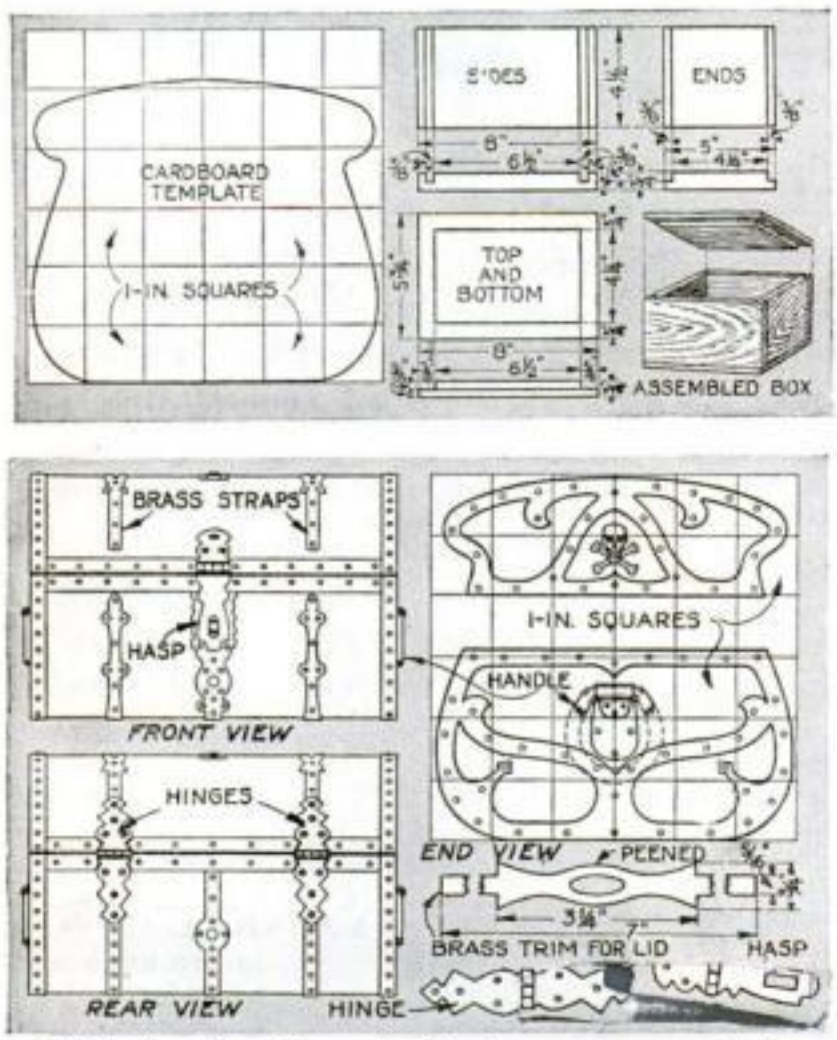
American black walnut is perhaps the best wood for a chest of this kind; one well-seasoned, straight-grained board ¾ by 6 in. by 4 ft. is sufficient.

The brass straps were cut from worn linoleum binding. The end decorations were at one time the lining of a pump cylinder which a plumber sold me for ten cents. This piece was heated to a cherry-red color over a gas burner and allowed to cool gradually so that it would be soft and workable; then it was flattened into a sheet. The two ¾-in. hinges, the hasp, and a small lock were obtained for $1.25, and the two 1¼-in. handle rings were purchased in a harness shop for ten cents. The trimmings were nailed on with ¼- and ⅜-in. brass escutcheon pins.

The tools used were as follows: Saw, hammer, small plane, try-square, chisels, gouges, drill, bracket saw, files, a sharp knife, and a home-made miter box.

The six pieces for the box are cut to the dimensions indicated and carefully squared. The dado and rabbet joints are marked accurately with knife, try-square, and marking gage, and the waste wood is removed with a chisel. The joints then are glued and the box clamped together. Do not use any nails or screws.

PREPARE a cardboard template for the ends and lay it on the middle of one end with the bottom even with the bottom of the box. Trace around the pattern with a sharp pencil; then mark the other end similarly. Clamp the chest in a vise and gouge and plane away the sides to the desired shape. Save the cardboard from which you cut the template and use it as a gage for applying to the sides as you work them down to the finished profile. If you have what carvers call a "quick" gouge—a sharply bent gouge—use it in cutting away the wood under the protruding curve of the top. Then wrap sandpaper around a dowel for smoothing this recess. Finish the work with a scraper and sandpaper.



Working drawings of the parts of the box proper, a template for the ends, and views showing the brass work, hinges, and hasp.

To separate the lid from the body of the chest, place the box on a flat surface and with an improvised gage draw a pencil line all around 3⅛ in. above the bottom. Saw to the line and dress the edges with sandpaper. Then use a block plane to make the lid and base fit exactly flush.

The first step in preparing the brass work is to cut the cardboard end template into two parts representing the end of the lid and the end of the box, and then lay out and cut patterns for the brass as shown. Transfer the design to the metal by following the edges with a pencil; then scribe them with a scriber or sharp awl.

Drill holes in the waste metal where necessary to receive the end of a saw

blade. Lay the work over a V-notch in the end of a board clamped to your bench and use a jeweler's saw or a small coping saw for the cutting. Dress the edges with files and emery cloth. Use the finished pieces as patterns for laying out the brass work for the other end. Center punch and drill holes for the escutcheon pins, placing them about 5/8 in. apart. Then nail on the decorations.

THE hinges, which are rectangular when purchased, are filed to the shape illustrated and annealed so that they can be bent to conform to the curve of the lid and the base.

The small brass hasp is similarly treated. That part of it which goes on the bottom should be sunk flush with the surface and covered with a wide brass strap, to give a more workmanlike appearance. The ring projects through a hole cut in the strap.

A study of the illustrations will show how the remaining trimmings are applied. The handle rings are hammered slightly D-shaped. A small brass chain prevents the lid from falling too far back. Rubber-headed tacks prevent the bottom from scratching the surface upon which the chest is placed.

The next step is to add several hundred years to the age of the chest and give it the appearance of once having been rescued from a burning galleon. Scorch it black here and there with a blowtorch or a small alcohol lamp. In one or two places let the flame burn wide, shallow depressions.

Apply judiciously a few scratches and bruises and scrub the whole exterior vigorously with a stiff wire brush in the direction of the grain.

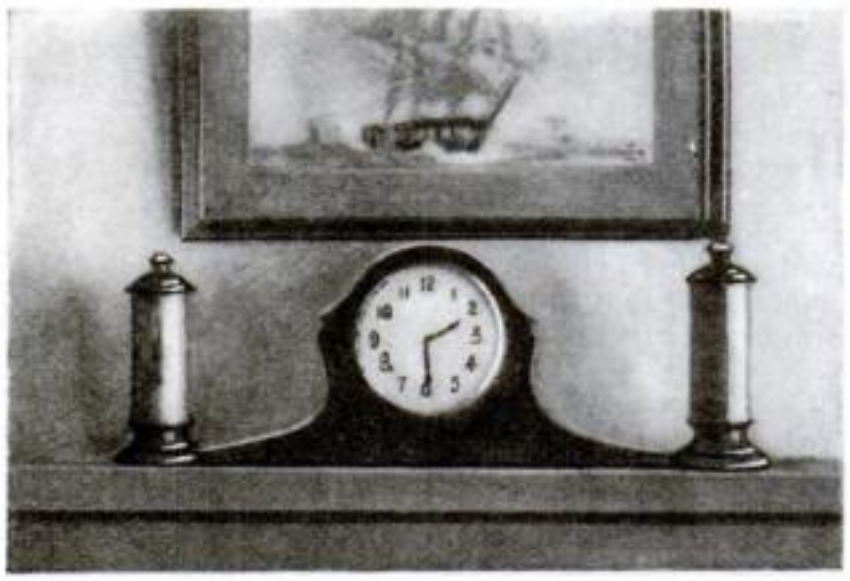
FILE the corners and the brass work at a few points. The brass may be roughened by applying acid here and there with a small brush and washing it off with baking soda and water as soon as it has done its work. When the metal is dry, rub it briskly with fine steel wool.

Obtain dark paste wood filler, or color natural filler with dark brown tinting color ground in japan, and rub this against the edges of the decorations, wipe off the excess, let the paste dry several days, and then give the chest two or three coats of hot linseed oil thinned one half with turpentine. Rub the wood vigorously after each application of the thinned oil.

To antique the brass, mix green ground in japan with enough turpentine to make a thick mixture and apply it over all the metal work. Allow this dressing to dry for five or ten minutes and rub it off lightly, allowing the green to remain in the depressions and rough spots. A little dark brown added in the same manner as the green will make the brass look still older.

If you desire to line the chest, cut stiff cardboard or thin wood to fit each inside face, pad the pieces with cotton, cover them with silk, and then set in the bottom first, put the two opposite sides in place, and finally fit the two end pieces, which will wedge in and hold all the padding.

Decorative Glow Lights



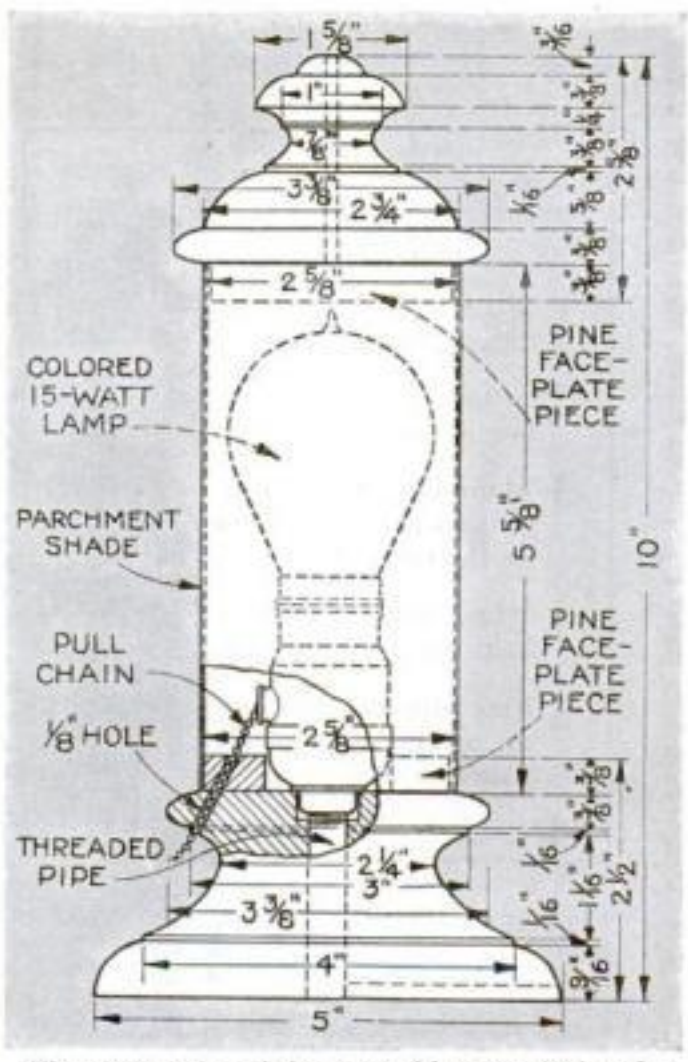
Lights such as these not only serve to ornament the mantel, but their light will give the entire room a glow of hominess and warmth.

By RICHARD GRAVES

SIMPLICITY of construction and attractiveness of design make the glow lights or torchères illustrated a worth while problem for the amateur wood turner. The lathe operations are of the simplest, and the small amount of electrical work required should not prove a stumbling block for anyone.

While mahogany or gumwood are among the best suited for the construction, any close-grained wood may be used and finished to suit the individual taste.

In making the top it will be necessary to glue a piece of 1-in. pine beneath the hardwood block in order to have a large enough surface to attach to the faceplate. In the construction of the base, however, the faceplate can be attached directly to the bottom of the hardwood block.



The construction of the top and bottom requires the most elementary of faceplate turning operations.

As each piece is completed, sand it thoroughly, apply the finish, and polish it while it is still in the lathe.

Bore a hole in the center of the base, using a bit of the same diameter as the 2-in. length of threaded pipe that is to be used for the electric cord.

Concentric with this, bore in the top surface holes just large enough to receive a pull-chain electric light socket as shown in the accompanying drawing.

The pull-chain of the socket is passed through a ⅛-in. hole drilled at one side as indicated. Before threading the chain through, it may be removed from the socket mechanism, passed through the hole, and then refastened. It is essential to bore a hole in the toppiece to serve as an air vent.

The shade is made by bending a piece of 8¾ by 5⅝ in. parchment into a cylinder having a height of 5⅝ in. and a diameter of 2⅝ in. Paper fasteners can be used to hold the cylinder together. They should be placed so that the prongs come on the inside.

After the shade has been bent to shape, it can be decorated with artist's colors; or a decalcomania transfer can be used. In any case the shade should be given a thin coat of shellac and allowed to dry thoroughly before it is put in place on the light.

Insert the shade over the 2⅝-in. projection on the base, and fit the top in place, making sure that the heads of the paper fasteners are placed at the back. The shade may be glued fast to the top but not to the bottom, as provision must be made for changing the bulb.

The best decorative results are obtained if an amber or flame colored bulb is used instead of white.

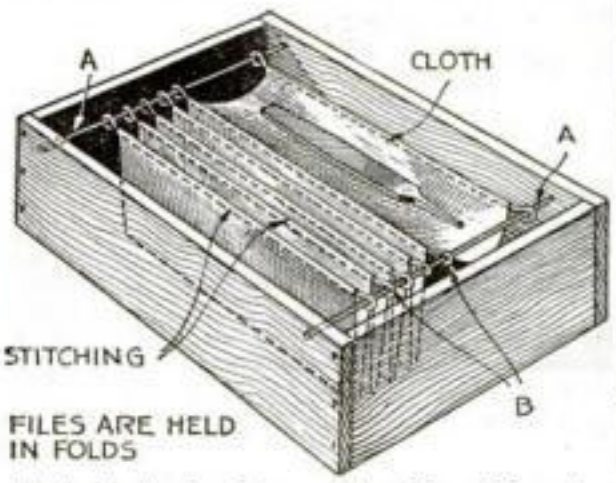
A STAR drill, so called because it has cutting edges radiating from the center, is the best tool to use for drilling concrete, brick, or other masonry. In the absence of this drill, an ordinary cold chisel will also do the work if it is slowly turned between the fingers as it is pounded with a hammer.

Folds of Cloth Safeguard Files in Tool Box

KEEPING files in good condition—and they are usually much abused tools—is not half so difficult if you provide a holder for them like the one illustrated. Each file is protected by cloth and is readily accessible.

The holder is a box 4 in. high, long enough to receive the longest file, and deep enough to accommodate the desired number of files. Two metal rods *A* are placed parallel to the ends of the box and at about ½ in. from the corners.

A piece of cloth having a width equal to the distance between rods *A* is sewed



Each file is placed in a fold of the cloth and is thus well protected from the other files.

on the rods *B* so as to have the loops of cloth come within about 1 in. of the bottom of the box. Rods *B* are bent to a loop at each end and slipped on the two rods *A*.

Similar boxes can be used for storing drills, reamers, cutter bits, and many other tools.—K. RENNER.

Stand Converts Hose into Garden Sprinkler

BY EQUIPPING your garden hose with an adjustable nozzle and the simple standard shown, it is possible to supply a 20 ft. diameter section of your garden with an even, gentle flow of water.

The standard, which can be easily made from scrap lumber, has four legs which are spread far apart to insure steadiness even with high water pressure.

The advantage of slow watering is obvious. First, it is not necessary to hold the hose in the hand; second, the hose can be left on until the ground has become thoroughly soaked; and third, thorough soaking is an essential if the best results in gardening are to be obtained.—H. B.

This wooden hose stand can be made from a few scrap pieces of packing-case lumber.

New Finishes for Woodwork

By BERTON ELLIOT

Wood trim can be antiqued by applying a mixture of raw umber and turpentine over a flat paint or an enameled undercoat.

ASIDE from the large group of paint, varnish, and enamel finishes for interior woodwork, there are a number of special finishes that the amateur craftsman can apply. These finishes harmonize with the more modern type of wall decoration and make it possible to carry out any desired color scheme on both walls and woodwork.

Three special finishes will be described—a stipple glaze, a gold bronze flat finish, and an antique finish. Before any of them can be applied, it is necessary to prepare a foundation of the dominating wall color. This foundation usually consists of so-called undercoaters or flat wall paint, and the number of coats varies with the condition of the surface. Twenty-four hours should be allowed between coats, and each coat should be sandpapered lightly and dusted clean before the next coat is applied.

The last undercoat can be stippled, if desired, to produce a pebbled effect. This is done by brushing the paint on a small portion of the surface and then working over it with a stippling brush before it has a chance to set. The ends of the brush bristles make tiny indentations in the paint. If a coarse stipple is preferred, a little dry plaster of Paris or whiting should be added to the paint.

The texture of the stipple can be varied by using cloth, chamois, or a stippling brush.

In applying what is sometimes called the stipple glaze finish, a small amount of painter's oil color or a special glazing color of the desired shade is thinned with turpentine, flatting oil, or a special glazing liquid and is then spread out on a piece of tin, glass, or board. The stippling may be done with a stippling brush or with a piece of crumpled cloth, chamois, or soft paper. The fineness or coarseness of the textured effect depends upon the stippling method chosen.

The brush or wad is moistened with the stipple color and patted on the surface. Considerable variety in the pattern may be obtained by varying the pressure and adding a twisting motion of the hand as the brush or wad is patted over the surface.

Ordinarily a very much lighter effect is preferred in finishing woodwork than in wall decoration, and the stipple color is not, as a rule, applied all over the surface. Pleasing results are often obtained by shading from the edges towards the center. On a door, for instance, the edges of the panel may be done first, when the stippling color has first been picked up; then as the brush or wad loses its color, the stippling is continued toward the center of the panel, the center being left practically in plain color. Casings and moldings may be treated in the same way, by applying a deeper stippling on the outside edges.

To produce a gold bronze flat finish, the final foundation coat is not only stippled as it is applied, but some gold bronze powder is patted lightly into the surface and stippled to produce a blended or clouded effect.

This is best done with a small wad of cotton batting dipped into the bronze.

Another special finish that is extensively used at present is antiquing. The background may be of any desired color, either in flat painted finish or an enamel finish built up in the usual way with a flat undercoater and enamel finishing coats. When dry a brown glazing mixture of raw umber thinned with turpentine is brushed on a small part of the surface and, before it reaches the "setting" point, wiped off with a cloth. A faint trace of the color strikes into the background coating, giving it the mellow, subdued effect ordinarily produced by natural ageing.

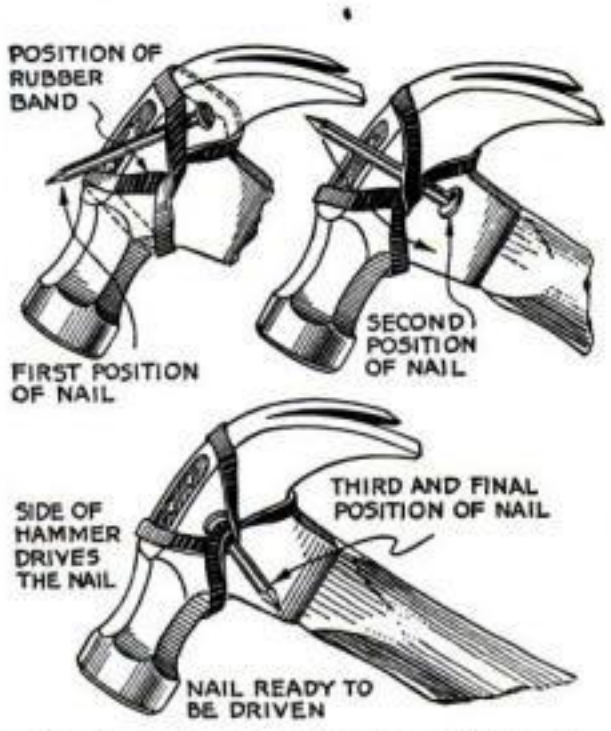
There is another method of antiquing, but it is adapted for use only on unfinished open-grain woods such as oak, walnut, ash, and elm. The wood is stained in the usual way and given an aged appearance by filling the pores of the wood with a gray wood filler. After the filler has been applied and the surface gloss has disappeared, it is wiped off with a cloth diagonally across the grain instead of straight across as in ordinary wood finishing. When the filler is thoroughly dry (not less than forty-eight hours should be allowed), thin coats of shellac are applied, followed by a coat of flat-drying varnish or lacquer, or by a waxed finish.

Rubber Band Helps Start Nails in Awkward Places

NAILS can be started in awkward places if they are held firmly against the side of a hammer head with a rubber band in the manner shown. The twisted band serves as a means of holding the nail upright and immediately releases the nail as soon as it is started into the surface of the wood.

Place the band over the head of the hammer, give it one complete twist, and place the other end over the claw (see illustration below.)

In putting the nail in place, insert it under one section of the cross formed by the rubber, move it toward the center, and then turn it to an upright position. Start the nail with one firm blow of the hammer.—R. G. HOTCHKISS.



The three steps in placing the nail between the twists of the ¼-in. wire rubber band.

How to Whittle a Toy Seaplane

ANY boy who is handy with his jackknife and a few ordinary tools can easily build the realistic twenty-passenger toy flying boat illustrated.

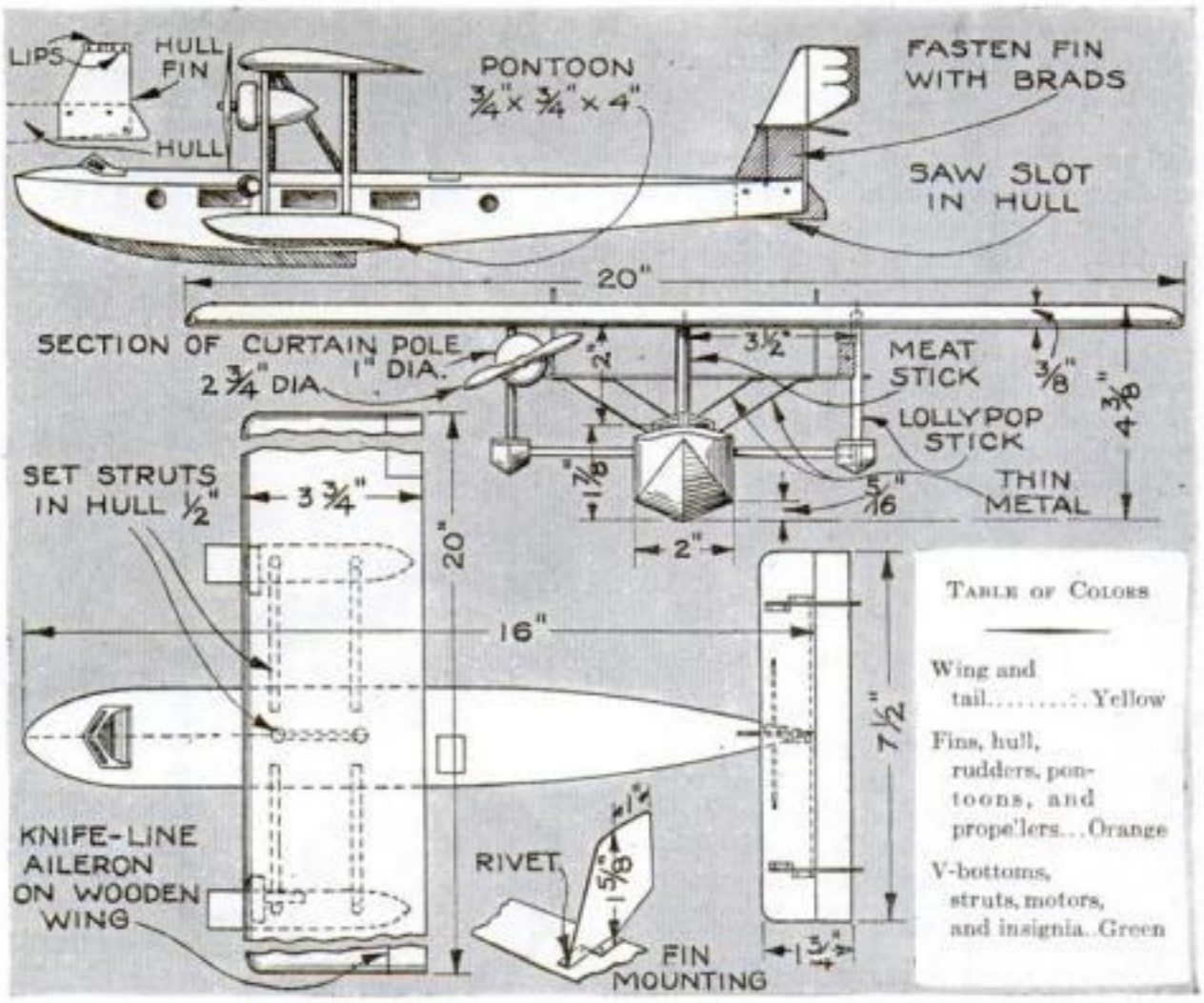
The hull is whittled from a 1⅞ by 2 by 16 in. piece of soft pine, the pontoons from ¾ by ¾ by 4 in. blocks, and the wings from a piece of stock ⅜ by 3¾ by 20 in.

The wing and pontoons are mounted on the hull with struts made from wooden meat skewers and lollypop sticks. A recess resembling a cockpit is cut in the hull, and a thin metal or pasteboard windshield is placed in front of it.

The two propellers are bent from ¼ by 2¾ in. thin metal blanks; and the motors, made from 1 in. diameter curtain rod, are fastened to the wing struts with brads and glue.

Thin metal is used in the construction of the elevator, stabilizer, and rudder unit, the members being riveted together as shown.

The ailerons are represented by knife lines.—DONALD W. CLARK.

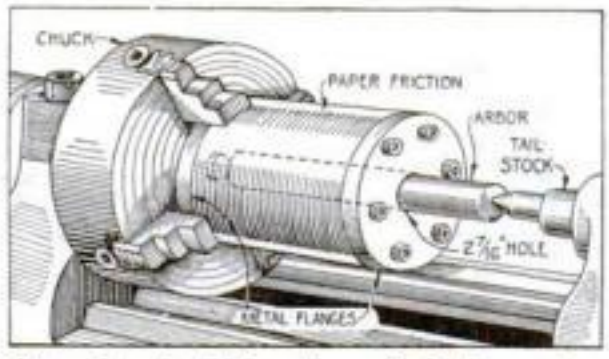


Dimensions and details of a twenty-passenger flying boat model. This is the first in a series of designs for the construction of whittled toy reproductions of the most modern types of aircraft.

Chucking a Paper Friction in the Lathe

REBORING a paper friction generally involves the difficulty of placing the cylinder in the chuck so that it will be centered and will revolve true.

This can be accomplished with little trouble, however, by placing the cylinder on an arbor that is a loose fit in the center holes of the flanges. Mount the arbor on the lathe centers and slide the friction up to the open jaws of the chuck; then carefully tighten the jaws up on the iron flange. While tightening the jaws of the chuck, rotate the arbor slowly with the hands to be sure that the work is well centered and is held true to the center line of the lathe.



The arbor should be a loose fit in the center hole of the paper friction being chucked.

Remove the arbor, and the paper friction can be easily bored with the assurance of having the hole absolutely in the center of the work.—JAMES ELLIS.

Folded Paper Airplane Explodes on Landing

A TOY airplane that will explode and burn when it hits the ground can be made by attaching a large match to the nose of an airplane made by folding a piece of paper to form the fuselage and wings.

A small nut similar to the kind used on dry cells is slipped over the stem of the match and allowed to rest against the head.

The match is then attached, head out, to the nose of the paper plane with a large straight pin.

As the plane hits the ground on landing, the weight of the small nut will cause the match to ignite and thus burn the plane.—ROBERT L. SHAW.

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TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. Each subject can be obtained for 25 cents with the exception of certain designs that require two or three sheets of blueprints and are accordingly 50 or 75 cents as noted below. The blueprints are each 15 by 22 in.

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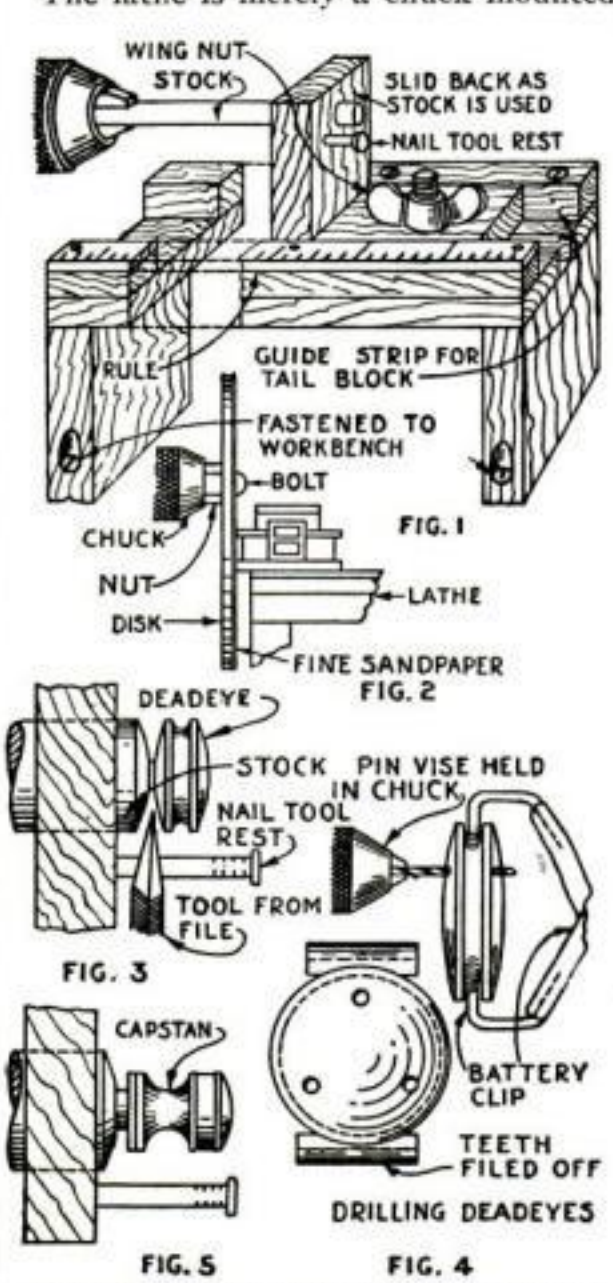
Homemade Lathe for Making Deadeyes

By KENNETH KOEHNLEIN

Model makers can turn their ship fittings easily and quickly on this miniature homemade lathe.

MOST amateur ship model builders find the making of deadeyes and other small fittings a long and tedious task. Excellent models sometimes remain unfinished because of the great number of deadeyes and blocks needed. With the simple lathe illustrated (Fig. 1), enough deadeyes can be turned out in a single evening to complete an elaborate model.

The lathe is merely a chuck mounted



The lathe can be used for turning, sanding, or drilling by chucking the stock, sander, or drill.

on a polishing head, electric drill, motor, or any other source of power. It can be used for turning capstans, trucks, carriage wheels, and kegs (Fig. 5), and for sanding small fittings (Fig. 2). By using two blocks as shown in Fig. 6, cannons, taffrails, and the like can be turned out.

I use dowel stock for the large deadeyes and white celluloid knitting needles for the smaller ones and also for blocks.

The stock is first chucked. The tailstock is then set so that the desired length

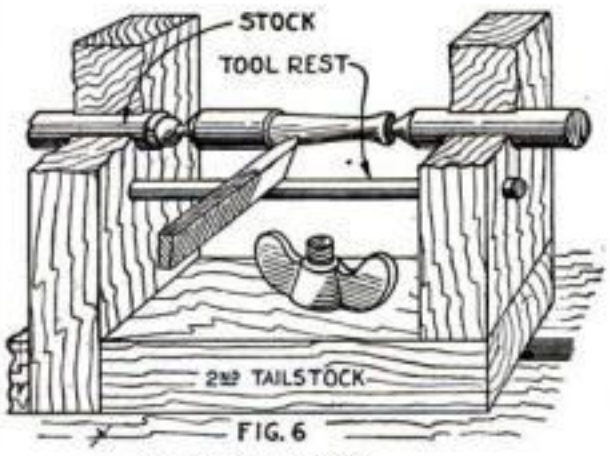


FIG. 6

TURNING CANNON

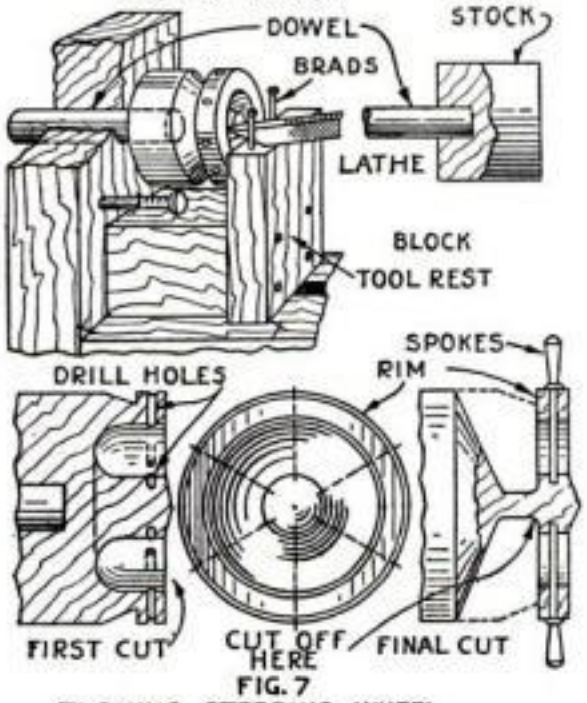


FIG. 7

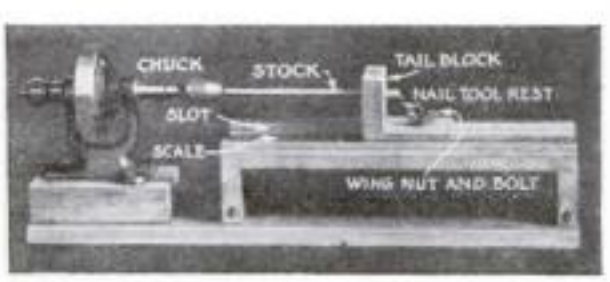
TURNING STEERING WHEEL

Cannon and steering wheels can be easily turned by changing the type of tailstock and toolrest.

of stock protrudes on the working side. The deadeye is turned to shape by using a small three-cornered file ground to a cutting edge (Fig. 3). It is sanded lightly with a strip of fine sandpaper and turned off the stock. The tailstock is then moved back, the rule on the guide strip (Fig. 1) serving as a gage for length, so that the next deadeye can be turned.

After the lanyard holes are laid out with a punch or sharp nail, the deadeye is held in a battery clamp while being drilled (Fig. 4), the drill being held in the chuck. If the chuck is too large to hold a small drill, place the drill in a pin vise, and the vise in the chuck.

The steering wheel is made of hardwood by the method illustrated in Fig. 7.



By moving the tailstock and noting the reading on the scale, any length stock may be cut.

Bringing Wall Switches within Child's Reach

MOST wall switches are too high for a small child to reach. A very simple and at the same time convenient method of bringing these switches to a lower level is shown in the illustration. An advantage of this arrangement is that the walls are in no way disfigured, and the device can be removed when it is no longer required.

The switch plate and switch should first be removed and a single flush outlet receptacle installed in its place. This is an easy change to make, since the two devices are mounted in exactly the same manner.

Pendant switch, plug, and wall receptacle form the extension.

Make up a short extension cord consisting of an 18-in. length of silk covered, parallel conductor lamp cord and an attachment plug and a small pendant switch. A through type switch may be used instead of the pendant switch shown in the illustration. In this case, the hole in one end of the switch body only is used, and the two wire ends are connected to the opposite sides of the switch.

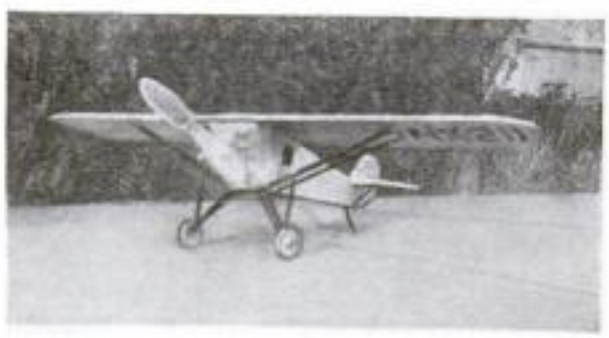
Insert the plug in the new wall outlet and the device is ready for use.—H. H. RUGG.

Model Plane Flies Too Fast for His Camera

KNOWING that there are many who would enjoy seeing the products of other readers' skill, Mr. Claire Wilson, of Calgary, Alberta, Canada, sent in the photograph below of his completed model of the *Spirit of St. Louis*.

In his letter Mr. Wilson said: "I was unable to get pictures of the model in flight, as I found that it flew too swiftly for the type of camera that I used. I found this model to be an excellent performer for its weight and size, and secured flights from 90 to 250 ft. when hand launched and also realistic R. O. G. flights of smaller distances. I found your blueprints very easy to follow."

Many excellent airplane models are included in our list of blueprints on page 111. These include a very light scale model of the *Bremen* (No. 87) and two noteworthy long-distance models (Nos. 102 and 104).

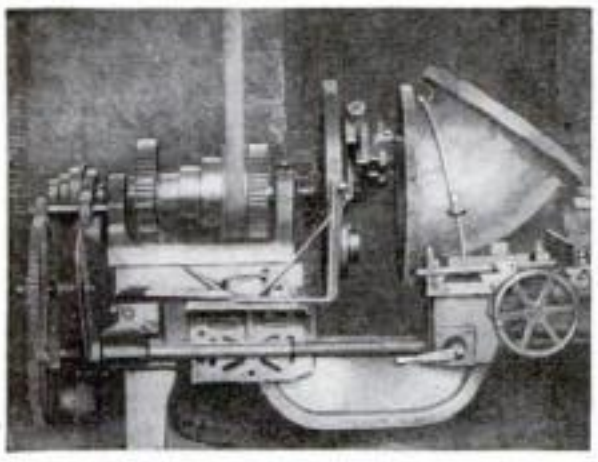


The model was built from POPULAR SCIENCE MONTHLY Blueprint No. 69 (see page 111).

Turning Heavy Pipe in a Small Lathe

IN CONSTRUCTING a large dam in India it was necessary to machine a large pipe bend so that it could be used as part of the sluice valve piping. Such a bend should be turned on a large lathe, but since none was available it was a case of doing the best with the machines at hand. As in many cases ingenuity took the place of proper facilities.

First, the bend was attached to the cross slide of the lathe by means of a



Cross-feed is obtained by having a pawl engage a ratchet wheel on the compound rest.

5/8-in. wire clamp, thus allowing the depth of cut to be adjusted.

A compound rest was bolted to the faceplate and a counterbalance arranged in order to insure smooth running. An L-shaped boring bar was adjusted on the compound rest and an arrangement for cross-feed was made by placing a ratchet wheel in place of the feed handle.

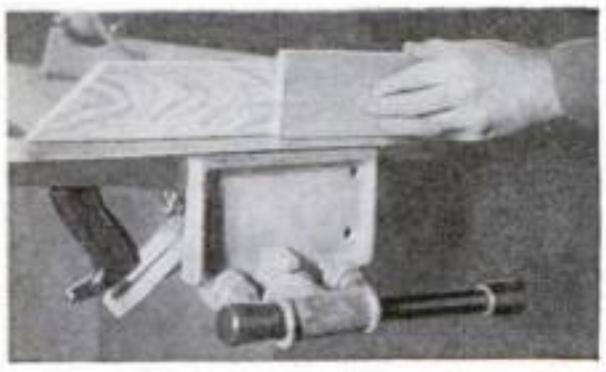
On the head of the lathe can be seen a bracket which holds the pawl; this in turn engages the ratchet once every revolution and thus supplies the necessary cross-feed.—R. J. SOMAN and D. G. SURNIS.

Accurate Jointing with Hand Plane and Guide

ACCURATE jointing or edge planing of thin stock can be accomplished easily by clamping a hand plane and wooden guide in a bench vise as shown.

Sharpen the plane iron to a razor edge and set it to take a very light cut. Then make a guide from a sound piece of stock and on the back of this nail a second piece about 5 in. wide, placing it so it will project 3½ in. below the lower edge of the first piece.

Fit the guide on the plane as shown and lock it in the vise, making sure that the fence is at right angles to the bottom of the plane. Hold the work edge up, press it firmly against the fence, and slide it over the cutter.—W. C. L.

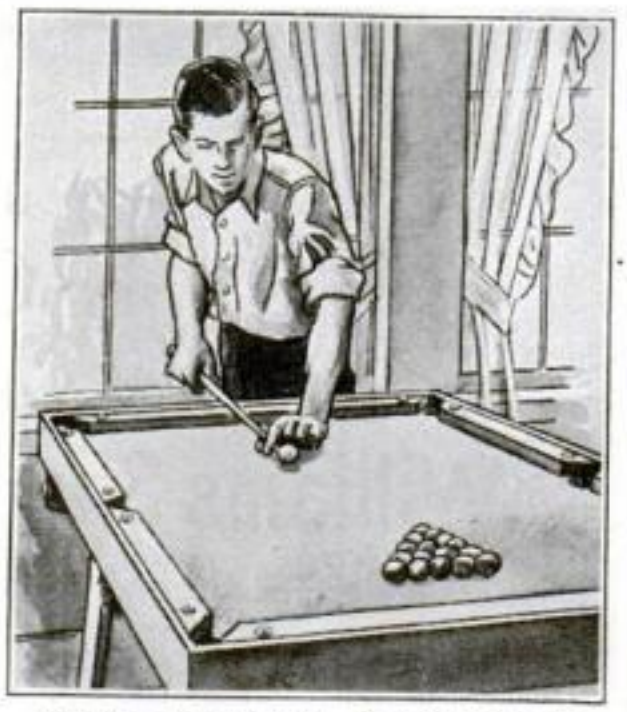


The guide is placed against the plane and the whole is held firmly in a vise.

Hints on Building a Game Table

IN BUILDING a small-size pool table (such as the type described in P.S.M., Mar. '29, p. 124), a few simple kinks can be applied that will not only simplify the construction but make the work more nearly perfect.

Small size billiard balls are hard to obtain and when they are obtainable are expensive. Imitation agate marbles, however, serve nicely. They come in many colors, are just about the right weight,



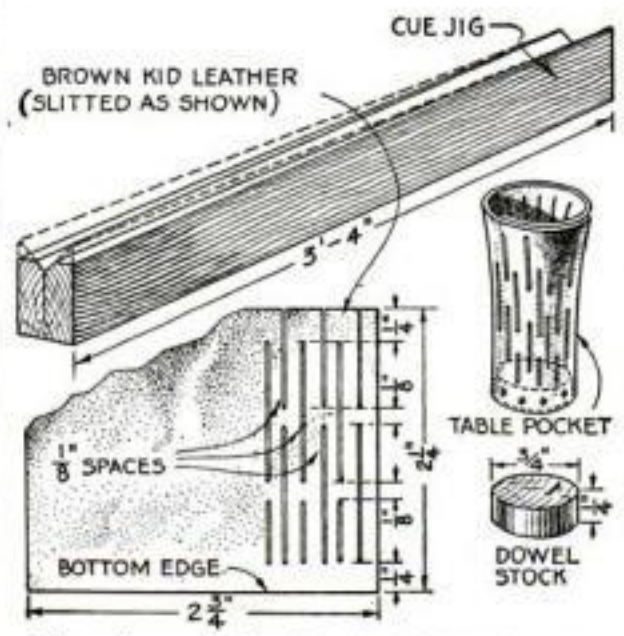
Imitation agate marbles, ⅝ in. in diameter and of different colors can be used as balls.

have the necessary life, and a whole set of these marbles, $1\frac{3}{16}$ in. in diameter, can be purchased for thirty-five cents.

Three- and four-bank shots are possible if ⅜-in. chemistry hose is used for cushions. Glue the hose in a groove cut in the sides of the table. The soft pliable rubber is preferred to the harder, reënforced variety.

Pockets can be easily made by using a piece of brown kid leather as shown in the figure at the top of the following page. The leather is cut as shown and fitted around a small piece of ¾-in. dowel. By allowing the edges of the leather to overlap a little, stitching the joint will be unnecessary.

Cues can be made from a 1 by 6 in. by 3



Dimensions of the jig for holding the cue blanks and method of making the pockets.

ft. 3 in. piece of well-seasoned maple. Smooth and straighten one side, turn the piece over and plane the opposite side to a taper, so that the piece measures 7/8 in. on one end and 3/8 in. on the other. Rip the piece down so that it will be 7/8 in. square on one end and 3/8 in. square on the other. Plane off the four corners thus giving you an eight-sided piece.

Continue the process of planing off the corners in this manner, holding the blank in a wooden jig such as is shown in figure at the top of the following page. This jig can be held firmly in a vise during the planing operation.

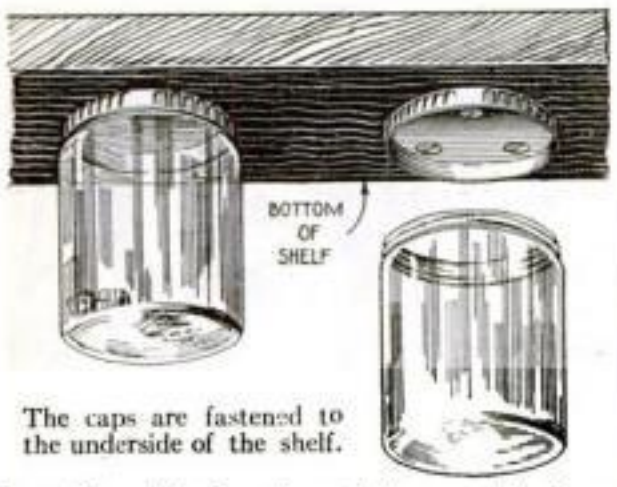
In the making of small-size cues the difficulty of obtaining tips small enough for use has always presented a problem. A serviceable tip can be made by driving ½-in. rubber-headed tacks into the tip ends of the cues and grinding them down to size. These tips have the added advantages of not coming loose easily and of being easily replaced.—G. A. REIMER.

Jars under Shelf Hold Hardware

BY SUSPENDING mayonnaise jars under your workshop shelves as shown, you can save space and at the same time keep screws, bolts, lock washers, and various spare parts in full view.

One twist of the jar will free it from its cover, and a like twist in the other direction will fasten it back in place.

The jars used are of the screw type having a tin cap. The caps are attached to the underside of the shelf with three screws and should be spaced so that there



The caps are fastened to the underside of the shelf.

is at least 1 in. clear between the jars when they are in place.—W. L. FAUROT.

Stopping a Leak in a Hot Water Tank

WHEN a hot water storage tank develops a leak, most householders consider it beyond repair. But a small leak can be stopped easily by driving a tapered plug of white pine or walnut into the hole. The plug should have a very gradual taper with the entering end almost as sharp as a needle. It is driven in with a hammer after it has first been soaked in water. The projecting end is cut off within half an inch from the tank surface.

A leak in a tank made of extra heavy gage metal may be repaired by driving a tapered steel punch through the hole. This turns the metal inward and forms sufficient surface so that the hole may be threaded. Inserting a screw of the proper size will stop the leak.

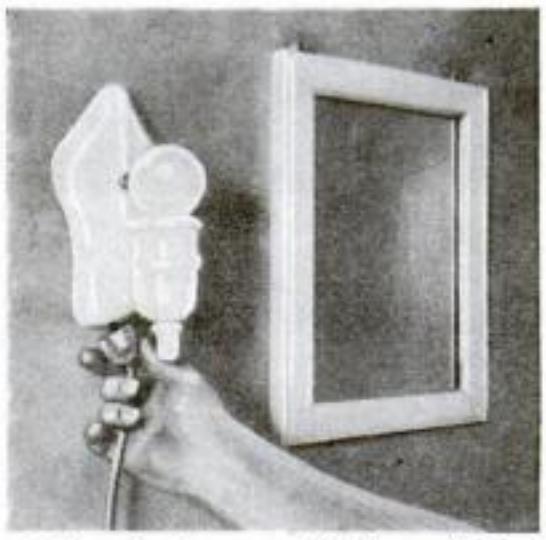
THE SHIPSHAPE HOME

Electric Fittings Designed to Do Double Duty

WITH the new and improved lighting fixtures, switches, bells, plugs, and various appliances now on the market, it is an easy matter to add to the electrical conveniences of your home. The accessories, for the most part, are simply installed, and each has some special feature and often does double duty.

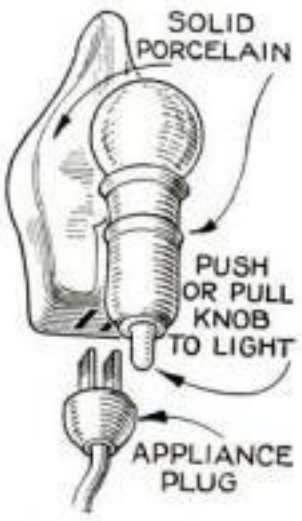
What wall fixtures are best suited for bathroom, kitchen, and washroom installations?

The latest wall fixtures for this use are made of solid porcelain. These fixtures,



Modern bathroom and kitchen wall fixture with extra appliance receptacle.

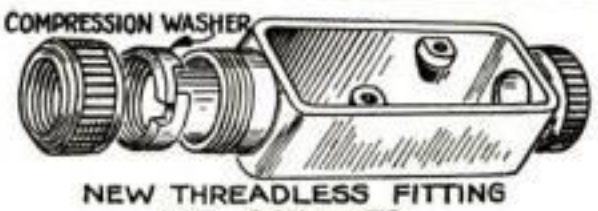
besides being practically indestructible, can be easily cleaned, and they reduce the danger of accidental shock in case of a short circuit or defect in the socket mechanism. One type of fixture has incorporated in it an appliance receptacle for connecting a heater, curling iron, or other apparatus. (See the accompanying illustrations.) A novel switch in the form of a pendant is also a part of the new fixture.



This wall light is turned off and on by a knob under the socket.

Can conduit installations be made without doing much pipe fitting and threading?

Yes. Threadless fittings (see illustration at top of page 119) are offered by several manufacturers. With these new conduit fittings, it is no longer necessary to cut threads on the ends of the pipe. The conduit is cut to the desired length, inserted into the fitting, and held firmly in place with one turn of the nut.



NEW THREADLESS FITTING FOR CONDUITS

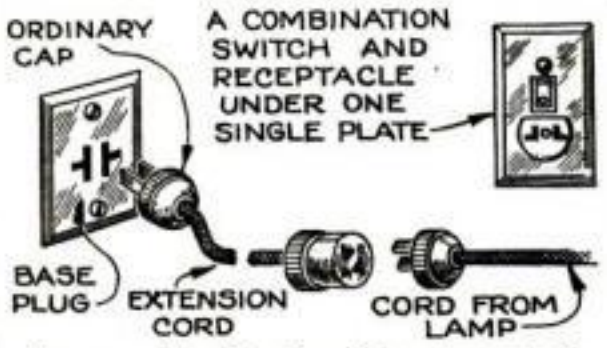
As the nut is tightened it forces the teeth on the compression washer into the surface of the pipe.

Is there a wall plate combination that includes a toggle switch and an appliance receptacle?

Where a switch and a receptacle for a plug are needed, a neat combination of the two can be obtained to fit into a single unit wall box. The switch may be used to control a light, and the receptacle made to operate separately; or the switch may be so connected that it will be possible to turn off the appliance with the switch instead of by the usual method of removing the plug. (See illustration below.)

What is the best method for lengthening a lamp cord that is too short?

Lengthening a lamp or extension cord with the aid of a taped joint is prohibited

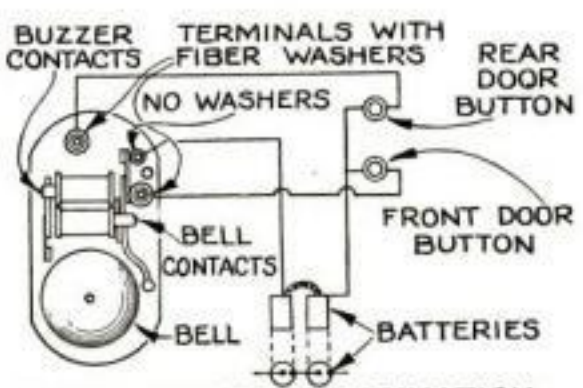


A new combined toggle switch and receptacle and the method of using a lamp-cord connector.

by wiring inspectors. The correct way to extend such a cord is by the use of a connector such as is shown in the illustration above. The desired length of wire is fitted at one end with an ordinary plug, and at the other end with a cord connector. The advantage of this method, aside from the fact that it is safer, is that the extension may be used on other lamps or appliances.

Can a combination buzzer and bell be obtained for use on the front and back doors?

A new combination, which includes a bell and a buzzer, is now on the market. The entire installation is no larger than an ordinary bell and is just as easy to connect. The wiring diagram is shown below.—HAROLD STRAND.



INSIDE VIEW OF COMBINATION. TERMINAL NOT INSULATED GOES TO BATTERY OTHER TWO CONNECT TO PUSH BUTTONS

Diagram showing simplicity and compactness of the combined doorbell and buzzer unit.

Easy Method for Bending Large Diameter Conduit

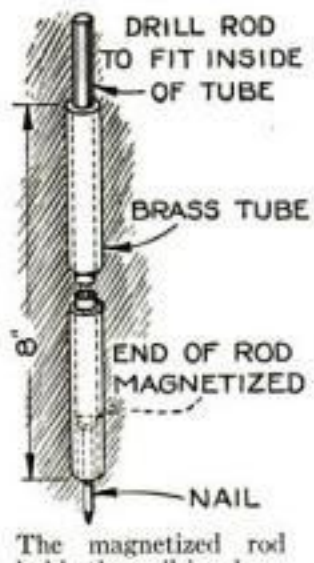
CONDUIT between 2 and 3 in. in diameter can be bent neatly with the aid of two heavy beams and two crosspieces bolted together as shown. The position of the crosspieces is determined by how far the bend is to be from the

The bending frame can be rested on a sawhorse.

end of the conduit, and a number of bolt holes can be bored to allow adjustments to be made quickly. The crosspieces should be of reasonably soft wood and care should be taken to do the bending cautiously to avoid kinking the conduit.

Simple Tool Facilitates the Driving of Nails

NAILS can be easily driven in awkward places if the simple tool illustrated is used.



The magnetized rod holds the nail in place.

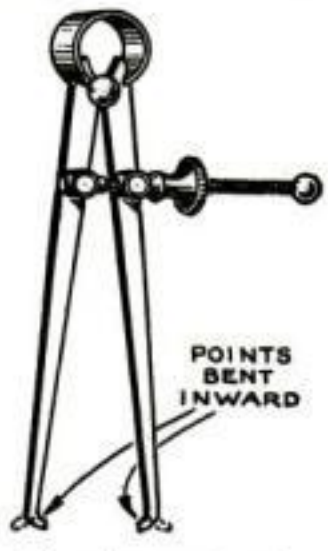
The tool consists of a brass tube about 8 in. long inside of which is placed a piece of drill rod having the same outside diameter as the inside of the tube.

The end of this rod is magnetized and serves to hold the nail in place, thus allowing the nail to be driven in awkward places.

Useful Tool Made from Discarded Calipers

WITH the expenditure of little time and trouble it is possible to convert a pair of inside iron calipers into a very handy measuring tool.

Heat the ends of the inside calipers and bend them so the points point in as shown in the illustration. These points can then be trued up with a file and the tool is ready for use. These calipers can be used in checking to see whether certain distances are equal, whether holes are equally spaced, and in doing many other odd jobs that are always bound to present themselves in machine shop work.—J. C. F.



The points are bent in and are then filed true.

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Sewing Stand Has Two Handy Trays and a Workbag

BESIDES providing ample space for sewing equipment, the convenient, lightweight, sewing stand illustrated also has a deep bag for unfinished work.

While the design is based on a segment of a circle, the construction should not be difficult for the home craftsman. If the pieces are accurately cut to shape, the assembling operations are not much more complicated than in rectangular work.

Two hinged flaps form the covers.

Mahogany, red gum, birch, maple, or cherry will serve well for the framework and top, but almost any wood may be used in the construction if a painted or lacquered finish is preferred.

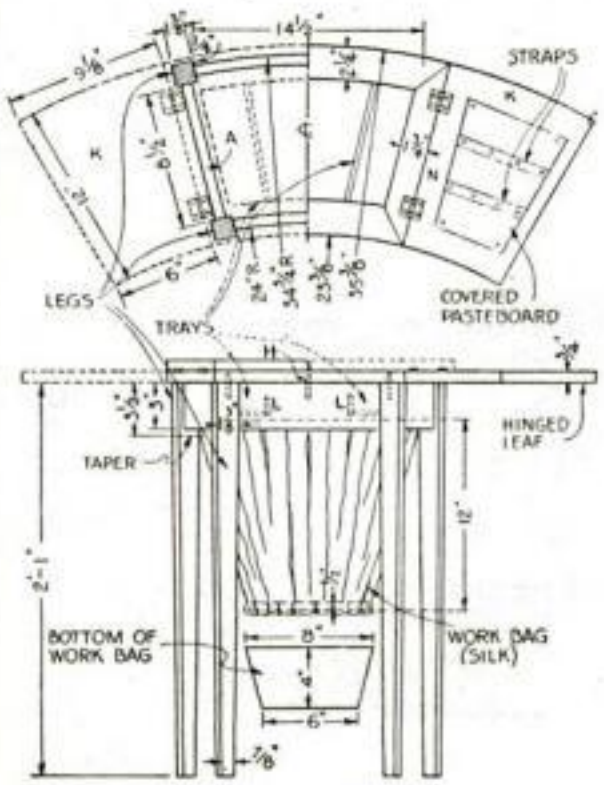
Get out the four legs, each 1⅜ by 1⅜ in. by 2 ft. 1 in., and taper them to ⅞ in. square at the bottom. This taper should begin 3½ in. from the top.

Make the ¾ by 3 by 8½ in. side rails *A* and fit them to the legs with three ⅜-in. dowels. The curved front and back rails can be band sawed from a piece of stock 3 by 3½ by 16 in. Sandpaper the straight rails and the legs and then glue each end of the stand as shown in the diagram on page 122 under the heading "first gluing."

Draw a full size top view of the legs, rails, and top. Place each pair of legs in position and dowel-joint the curved rails.

Try the pieces together and make two forms such as *B* from 1-in. stock. After a good fit is obtained, take the pieces apart, sandpaper the curved rails, apply glue, and clamp as indicated in the diagram marked "second gluing." Be sure that the outside corners of the legs are parallel. Square up the top of the assembly by bracing it until the diagonals are equal.

The two sidepieces *C* of the frame for



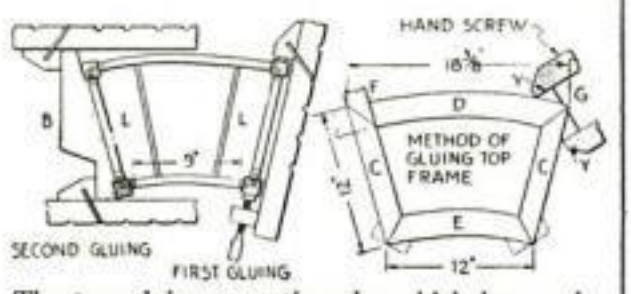
The design for the top is based on a segment of a circle. Note the leg and rail construction.

the top are made from a ¾ by 1¾ by 13 in. piece of stock, and the back member *D* and the front *E* from a piece ¾ by 2¼ in. and long enough to allow spare wood for finishing.

True up all the edges and place the parts on the full size plan to obtain the proper angles. Fit each joint separately, allowing about ⅛ in. in length so that the frame can be trimmed to the exact size.

On each joint attach small triangular blocks *G* so that they will act as bearings for the hand screw jaws *Y*. Fit ⅜-in. dowels in each joint and make a trial assembly of the entire frame. After a perfect fit is obtained, glue permanently with the aid of hand screws as illustrated.

After the glue has hardened, smooth and sandpaper the frame and fit it to the



The two gluing operations by which legs and rails are assembled; how to glue the top frame.

legs and rails with dowels as shown at *H* in the front view on page 121. Next, make the two flaps *K* and hang each one with two hinges.

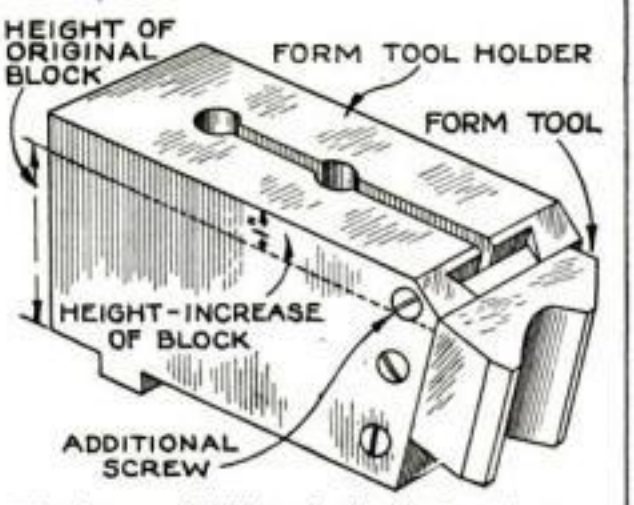
Two trays are made as shown and fastened to the stand as at *L*, being held in place with glue and brads.

The entire surface then should be sandpapered and the desired finish applied. If the wood is to be left in the natural color a simply applied finish consists of three or more thin coats of light orange shellac, each rubbed with No. 4/0 sandpaper. The last coat should be polished with wax.

Strap racks can be fastened on cloth-covered pasteboard, which in turn is attached to the flaps so as not to interfere with closing them.—CHARLES A. KING.

Increasing the Life of Form Cutting Tools

BY MAKING form tool holders a little higher and providing them with three binding screws instead of two, it is possible to obtain more use from any given length of tool stock. The extra screw allows the bit to be moved up farther and thus makes it possible to use the tools long after they would have become too short for the shorter type of form tool holder.—H. L. WHEELER.



The increased height of the block will provide space for the additional tightening screw.

Casting Concrete Stepping Stones in the Ground

STEPPING stone garden walks of the flagstone variety can be easily and quickly constructed by casting concrete to the various shapes desired right in place instead of molding the blocks or using the natural stones and fitting them together in the proper pattern.

First, lay out the path with stakes and cord to the width and general contour

The wooden strips can be lifted out ten minutes after the concrete mixture has been poured.

desired. Dig the path out to a depth of about 3 or 4 in., being sure that the contour follows the cord plan.

Set wooden strips edge up along the boundaries of the path and then lay out the forms that the molded stones are to occupy. In this way a good idea of the arrangement can be obtained.

In mixing the concrete, use one part of cement and between four and five parts of coarse sand. Mix this dry and then add sufficient water so that the mix is just wet enough to pour easily and not so soft as to be sloppy. Pour the cement into the box forms, being careful to see that all of the corners are filled and that the concrete is even with the ground.

After smoothing out the surface of the concrete, allow it to stand for about ten minutes and then carefully remove the wood strips. The cement will be firm enough to hold its shape and all that is necessary is to allow the walk from three to four days to harden.

When the concrete has hardened sufficiently to allow it to be walked upon, fill the cracks between the stones with soil. If grass seed is sown on this earth, it will soon sprout and add to the attractiveness of the stepping stones.

By pouring the concrete so that it is

Any flagstone design can be made by outlining the desired forms with short strips of wood.

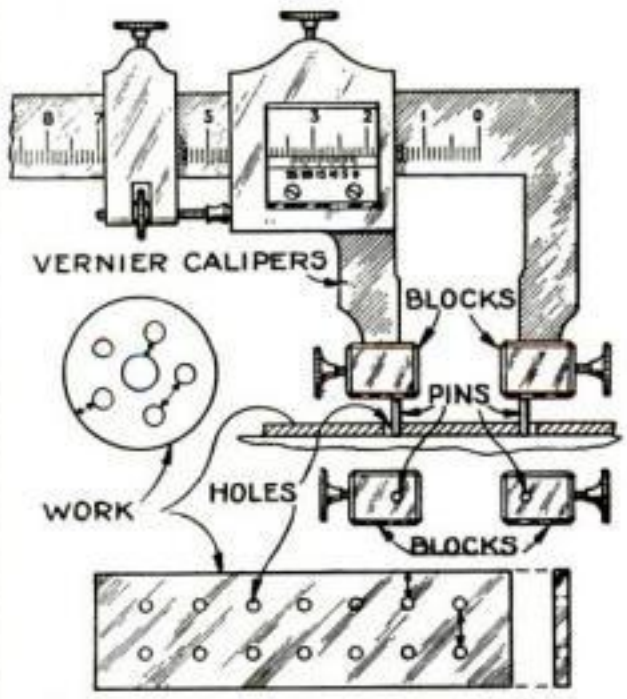
The finished walk should be allowed to harden for at least four or even five days before it is used.

flush with the surface of the surrounding soil, the walk will not serve as an obstacle for a lawn mower and thus will allow the easy cutting of the grass between and around the stones.—H. B.

Checking Small Holes with Vernier Calipers

BY THE addition of small pins fitted on the jaws of a pair of vernier calipers, it is possible to measure accurately the distance between small holes drilled in thin plate stock.

The pins are fitted in plugs which, in turn, fit the ends of the caliper jaws and are held in place with small thumbscrews.—JOSEPH C. FISHER.



The inside edges of the pins should be on a line with the inside edges of the jaws.

OUTSIDE painting should be done under favorable weather conditions. Never paint during or following a rain, heavy dew, or frost; in damp, foggy atmosphere; or when rain is threatening. Neither attempt it in freezing weather. If the surface is cold, the paint may crawl and sag. If the paint freezes before drying, the appearance of the job is ruined, and it is not very satisfactory even if painted over.

Spring is more popular than any other time of year for painting. However, spring painting should never be done (except in the warmer climates) until there has been sufficient dry, warm weather to overcome the effects of winter rain, ice, and snow. Fall is always a good time to paint, as generally there are few rains and the lumber is in good condition.

A definite program for getting ahead financially will be found on page four of this issue.

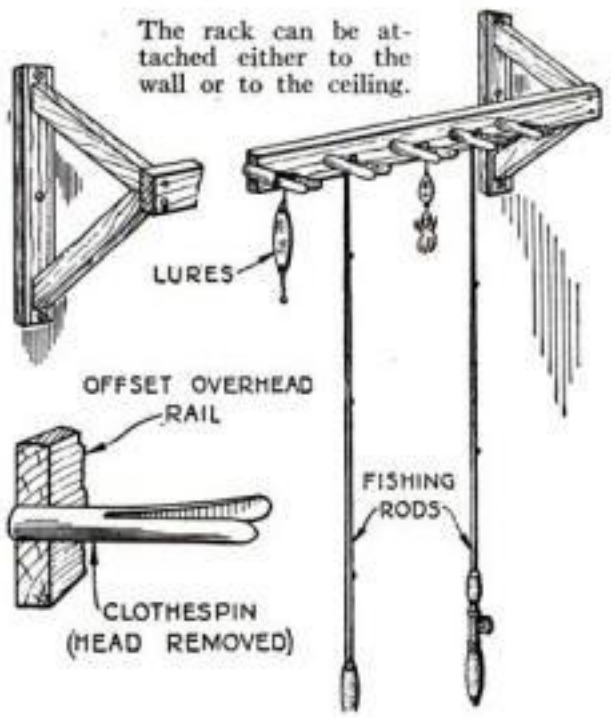
Easily Constructed Rack Holds Fishing Rods

ANY small amount of set that the tip of a fishing rod may have sustained in the course of a day's fishing can be removed if the rod is hung in the handy clothespin rack shown below.

The heads of a number of clothespins are shaved off and the pins inserted in holes bored in a strip of wood 1 in. thick and 2½ in. wide. This strip is attached to the wall by means of brackets.

The rack is especially useful in the case of those fishermen who use bamboo rods and wish to keep them in perfect condition and free from any set.

The rack can also be used for hanging lures and plugs.—ROBERT PAGE LINCOLN.



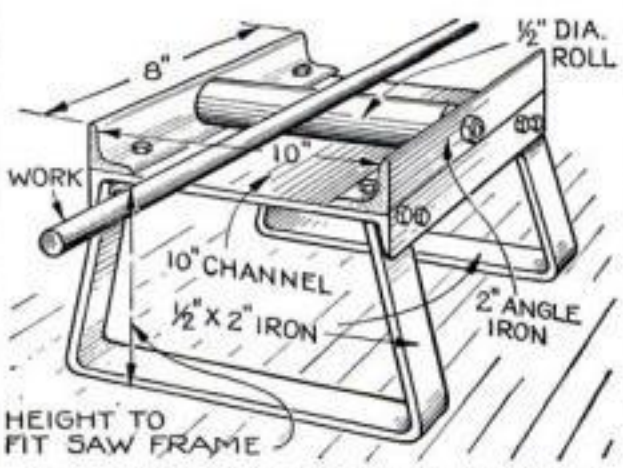
Support for Power Hack Saw Stock

A SUBSTANTIAL and handy support for rod stock which is being cut in a power hack saw can be made from short ends of scrap iron.

The parts assembled consist of two pieces of 2-in. angle iron, 8 in. long and bolted to a piece of 10-in. channel iron, which are supported from the floor by two legs which can be made from any suitable size of flat stock iron bent to the shape indicated.

A cast-iron or steel roll is placed between the angle iron supports to serve as a rest for the free end of the stock being cut.

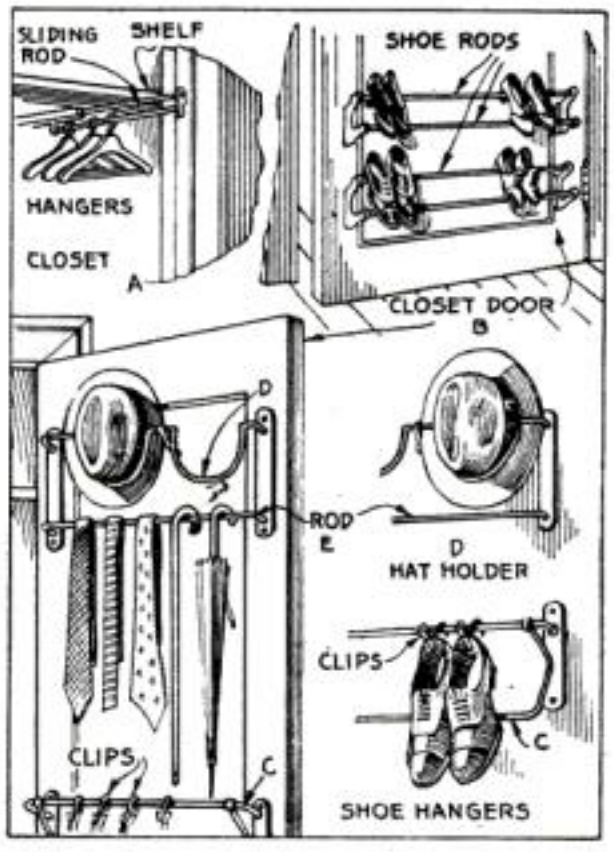
The height of the support should be made the same as the machine with which it is to be used.—H. L. WHEELER.



A ½-in. steel roller serves as a rest for the end of the stock being cut on the power hack saw.

Installing Closet Conveniences

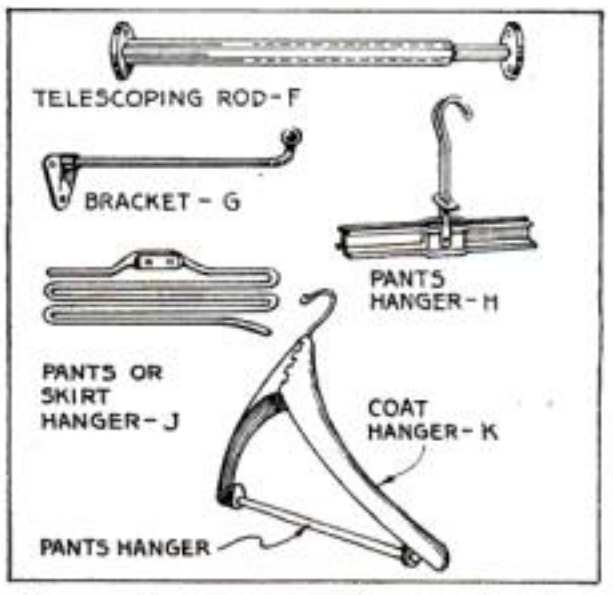
IN THE hardware store, the department store, the home furnishing store, and even in the "five and ten" may be found various inexpensive closet fixtures which add much to the capacity and convenience of any closet. To install them requires nothing more than the ability to use a screw driver, for usually all necessary screws and fittings come with them.



By utilizing the space on the back of the door the capacity of any closet can be increased.

The garment fixture *A* may be purchased in lengths ranging from 12 to 60 in. by increments of 2 in. The shoe racks *B* and *C* come in lengths to suit almost any space on a door, a wall, or a baseboard. The rack *D* has obvious advantages, while the rod *E* is a hanging place for neckwear, belts, canes, and umbrellas.

The adjustable closet bar *F* may be purchased in three sizes, 18, 30, and 48 in., one of which will suit any space between 18 and 78 in. The bracket rod *G* is made in 10- and 20-in. lengths and will support a surprising amount of clothing in a small space. The hanger *H* for trousers is more substantially made than many others of the same type; it may be used for hang-



Hangers of various types. These cost little but add much to the convenience of the closet.

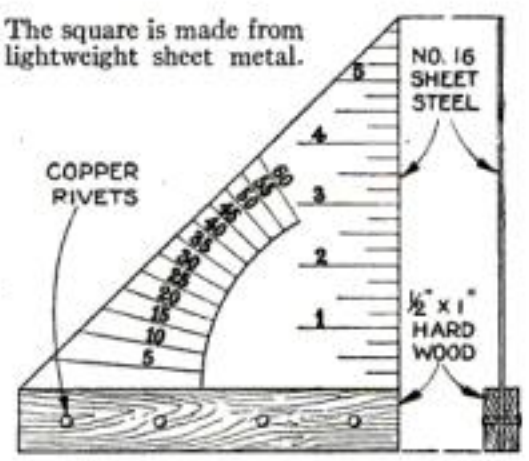
ing skirts as well. The hanger *J* will accommodate four pairs of trousers in a restricted space.

Coat hangers of many kinds can be bought. The one shown at *K* is of somewhat unusual design and will preserve the shape of the garment, besides supplying a convenient rack for an additional pair of trousers.

After fixtures of these types are added, the walls of the closet in many cases will carry nearly as many clothes hooks as before, so that the capacity is greatly increased and, at the same time, a more orderly and convenient arrangement is insured.—DAVID WEBSTER.

Steel Square Simplifies Structural Layouts

A CONVENIENT square for use in laying out either timbers or structural steel can be made as illustrated by cutting a right-angle triangle from lightweight sheet metal. The triangle is extended 1 in. below the base line for attaching the wooden guides, which are

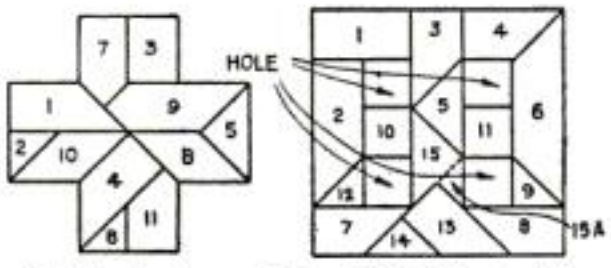


fastened in place with four soft copper rivets.

The completed tool can be used for the same purposes as the ordinary try-square. In addition it gives a 45° cut without making any adjustments or moving the square, and the graduations allow an angular cut of any desired degree to be marked without stopping to adjust screws or clamps.—C. B. DEAN.

Block Puzzling—The Latest Craze

BLOCK puzzling, which is fast becoming popular with puzzle enthusiasts, is not new to the readers of POPULAR SCIENCE MONTHLY. Puzzles of this kind have been described in this magazine many times in the past, and six especially ingenious puzzles of this type are included in our Blueprint No. 65 (see page 111). The solutions to the last two puzzles published (P.S.M., Mar. '30, p. 133) are given below.



Solutions to two puzzles by E. B. Roberts. The pieces may be cut from wood or cardboard.

An Escape Trick and Envelope Mystery

By GEORGE S. GREENE

Escape from these witch stocks seems an almost impossible feat to those not in the know.

DOING what seems to be the impossible is one of the requisites of all magicians, amateur and professional. For instance, escape from the "witch stocks" illustrated would be quite a feat—unless you knew just how the trick is done.

The effectiveness of the trick is only surpassed by the ease with which the stocks can be constructed and the simplicity of the trick itself.

The stocks are made of 1 by 2½ by 11 in. boards. The oval wrist holes are 2½ in. wide, 2 in. high, and are 3½ in. apart. The boards are fastened at one end with a steel hinge, at the other with a brass hasp and lock.

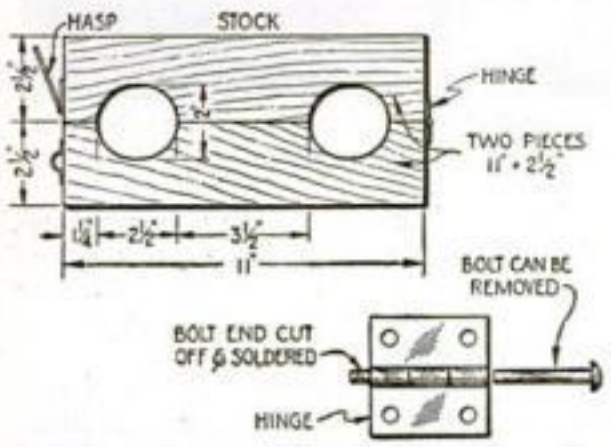
In preparing the hinge, remove the pin and saw a ¼-in. piece from the end. This piece is soldered back in the hinge, projecting slightly, and the remainder of the pin is replaced from the other side. Bend the pin very slightly so that it requires a pull of the finger nail to dislodge it. A push on the bolt-end soldered in the hinge will convince anyone that all is secure and that the bolt could not possibly be removed without a hammer and

By twisting the left hand, to position shown, the pin can be withdrawn from the fake hinge.

freedom of the hands for swinging it.

A small quantity of burnt umber dissolved in alcohol and dabbed on the wood with a cloth adds to the antique appearance, as does the rusting of the hardware by moistening it with salt water. Care should be used to polish and oil the inside of the hinge and the bolt after this treatment.

Often an antique padlock and key can be purchased at a secondhand store, and



Drawings of the assembled witch stocks and diagram showing construction of the hinge

if they are not sufficiently worn with age they can be made so artificially. The use of a marked piece of adhesive tape over the keyhole after the stocks have been locked on dispels any thought that a duplicate key is used.

When the stocks are locked on the performer, using a borrowed padlock if desired, he has only to go into retirement behind a curtain for a moment to remove them. He twists his left arm around and removes the pin with his finger nail to make the escape (see illustration bottom of page 128). The bolt is replaced before allowing the stocks to be examined. Close inspection will not reveal the secret, and considerable fun can be had by offering to allow a spectator to try to make the escape.

Much of the success of the trick, of course, depends on the manner of presentation. A well planned "patter" (talk) has been prepared and can be obtained by sending a stamped and self-addressed envelope to POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, with a request for Home Workshop Bulletin No. 4.

In performing the bewitched ribbon trick, you show an empty envelope, a yard of ribbon, and a playing card. A slit is made through the envelope with a knife and the ribbon is threaded through it so that half of its length hangs down on either side. The playing card is marked with a number or name suggested by the

The arrangement of the envelope, showing the duplicate card, tracing paper, and false front.

When the envelope is opened the ribbon is found to be threaded through the playing card.

audience and then sealed in the envelope. When the envelope is again opened and the marked card is withdrawn the ribbon will be found to be threaded through it as shown in the illustration above.

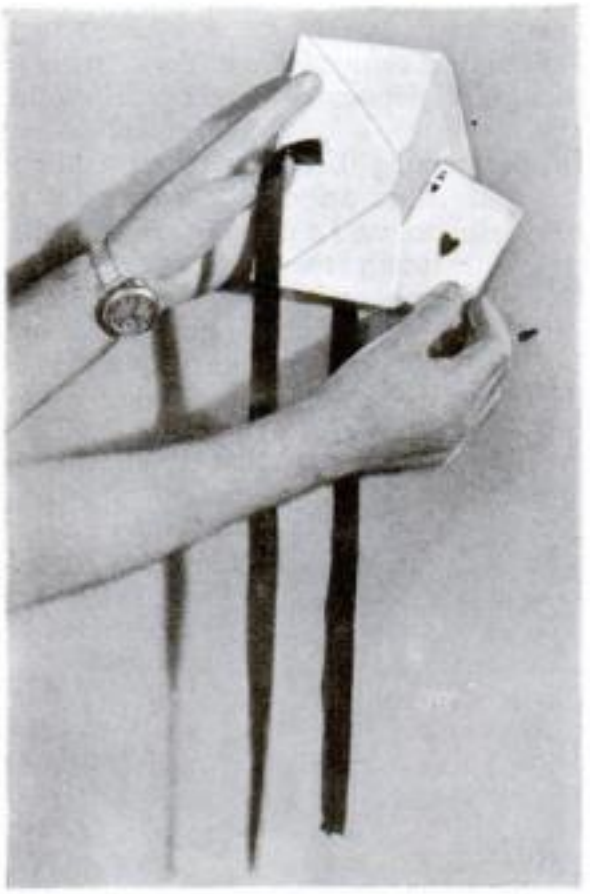
The ease of the trick lies in the simple preparations. The envelope has an inner partition consisting of the front and flap of another envelope, with the two flaps sealed together.

Inside of this secret partition is a sheet of red carbon paper and a duplicate playing card, arranged so that writing on the envelope face will place an impression on the duplicate card.

The pencil used to mark the original card, which is rested over the envelope during the marking, is a red one in order to exactly match the carbon impression. Red is chosen because it is one of the easiest colors to match.

It will of course be understood that when the ribbon is first threaded through the envelope, it also passes through the duplicate card. On removing the latter at the conclusion, the carbon paper is retained in the envelope by having been previously glued at the corners.

Much of the success of the trick depends on the careful arrangement of the envelope, fake back, duplicate card, and red carbon paper and on the ease with which the duplicate card is removed.



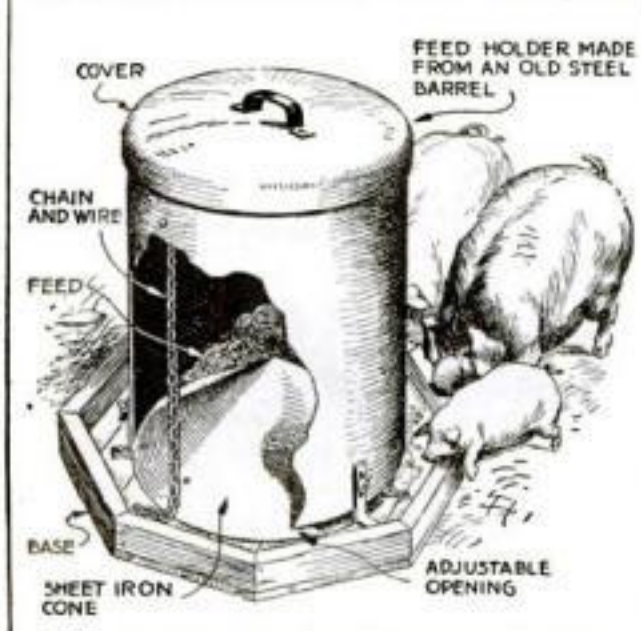
The ribbon is threaded through the envelope and then the marked playing card is inserted.

Cheap Self-Feeder Reduces Cost of Keeping Pigs

WITH the expenditure of but a little time and money, it is possible to supply a farm with a waste-preventing self-feeder for pigs as shown below. The practical value of this design can be gaged by the fact that Prof. B. V. McCaul, of the North Dakota Agricultural College, has built several of them for use on his own farm.

The main part, or hopper, of the feeder is made by removing the top and bottom of an old steel oil barrel. This can be accomplished by cutting it with an ordinary cold chisel.

The framework for the base can be either six or eight sided. Construct the frame from 2 by 4 in. stock, making it large enough to allow a minimum space of at least 8 in. from the outside of the barrel to the inside of the frame. A floor of



An old steel oil barrel with its top and bottom removed serves as the hopper for the feed.

1-in. boards is nailed to the underside of this frame.

The inside cone is made of lightweight sheet iron and should be about the same in diameter as the inside of the barrel and about 8 in. in height.

The adjustable legs are made from pieces of 1 by 6 in. strap iron. Bend each piece to a right angle at about 2 in. from one end and supply the opposite end with a slot. Bolt the shorter end to the base, and fasten the slotted end to the barrel with wing nuts, which allow the flow of the feed to be adjusted easily. Careful adjustment will eliminate any waste of feed.

In order to keep the feed always free and unclogged, three or four chains (made by wiring several lengths of old tire chain together) should be attached to the inside of the barrel near the top and allowed to hang down and come out through the feeder opening. The lower end of each chain should be fastened with staples to the base out near the inner edge of the frame.

The pigs will move the chains as they eat and thus keep the feed loose and working towards the opening. The hopper should be provided with a tight-fitting cover to keep out rain and moisture. This can be made of either wood or thin sheet metal.

If kept in good condition, a feeder such as this should accommodate about ten or eleven 250-lb. pigs.—CAP E. MILLER.

HOME WORKSHOP CHEMISTRY

Simple Formulas That Will Save Both Time and Money

FOR cracks in floors and other woodwork that are too wide to be filled satisfactorily with common types of crack fillers, a hard, nonshrinking filler can be made as follows:

Heat ½ lb. of yellow ochre (a finely powdered pigment obtainable at any large paint store) over a flame to drive off all moisture. Melt ¼ lb. of rosin and add to it ¼ lb. of thick turpentine, but remove the rosin from the fire before adding the turpentine. To this add the ochre and heat the mixture to keep it liquid until it has been thoroughly stirred.

The mixture is heated and poured into the crack; any excess is removed after it hardens.

Allow the filler to cool, and if it does not harden, add more of the rosin and yellow ochre.

To use the mixture, heat it and pour it into the crack, which must, of course, be bone dry. Any surplus can be removed with a chisel after the filler hardens.

Carpenter's glue diluted with twice its usual amount of water forms an efficient hardener for use with plaster of Paris.

The dry plaster is worked up with the diluted glue in the same proportions as when used with plain water. If potassium bichromate is added to the glue before it is mixed with the plaster, the resulting hardened mass will be more or less resistant to moisture.

FOR staining small pieces of wood where it is necessary only to cover up the natural color and where high-grade commercial wood stains are not essential, it is possible to use chemicals. For example, by adding a teaspoonful of potassium ferrocyanide and another of ferric chloride to a glass of water, a blue stain can be obtained. If the color is not distinct enough, the addition of a teaspoonful of oxalic acid will generally bring it out.

A deep brownish-black or dark sepia stain can be made by adding six teaspoonfuls of pyrogallic acid and two of cupric chloride to a quart of denatured alcohol.

To prepare a greenish-blue stain, add to a glass of water one or two teaspoonfuls of oxalic acid and one teaspoonful of ferrocyanide, or one teaspoonful of ferrous sulphate and one teaspoonful of potassium ferrocyanide.—H. BADE.

Remodeling a Tool Grinder to Do Tap Fluting

By O. S. MARSHALL

REFINEMENTS in modern machine shop taps demand that the flutes be spaced and ground accurately. As yet no special machine is available to do this work, but with the application of a few simple attachments it is possible to convert a small tool and cutter grinder into

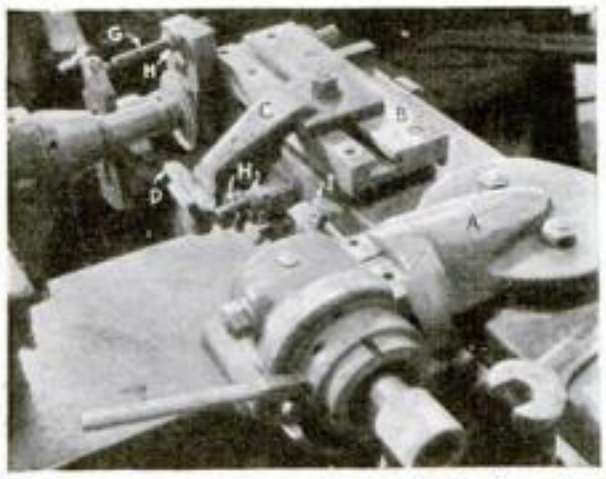


Fig. 1. The grinder set-up and wheel-truing device used to flute center-supported taps.

an accurate flute grinder and spacer for use on small taps.

In Fig. 1 is shown the equipment needed in grinding center-supported taps. The regular top or auxiliary swivel plate of the cutter grinder table was discarded and in place the two members *A* and *B* were substituted. Part *A* occupies the swiveling point of the main table, while *B* rests on lugs screwed into the table top. These lugs insure the alignment of parts *A* and *B*. Part *B* carries the tailstock center *C*, which supports a double-ended center *D*. One end of *D* is a female center, which can be used for supporting small pointed end taps.

The wheel-truing device is secured underneath *B* with two screws, and is capable of being set at an angle. With the correct setting of the diamond, truing is simply a matter of bringing the worktable to a position where the diamond will touch the wheel and rotating the diamond holder. To make the wheel keep its proper form and also relative position for the tap-flute, a setting bar *G* is provided. Part *G* is adjustable with micrometer precision by means of the knurled and graduated nuts *H*.

Tap flutes are set in proper relation to

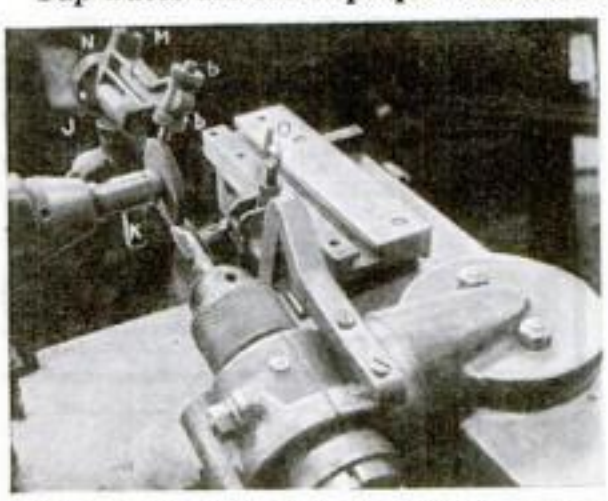


Fig. 2. A chuck attachment makes it possible to grind the negative angle in gun-tap fluting.

A definite program for getting ahead financially will be found on page four of this issue

the diamond position by means of a similar micrometer adjusting device *H*, which is attached beneath the tailstock *C*. A clapper-block arrangement permits the locating bar to be swung clear of the tap and thus allows grinding room. The headstock *A* carries the live center and a forked dog, which is held in place by *I*.

A chuck-holding provision for the same machine is shown in Fig. 2. In this case the work is held by the shank only, thus allowing *gun tap* fluting to be ground.

The headstock member permits both horizontal and vertical settings of the work in relation to its path of travel against the grinding wheel.

The special radius-truing device *J* makes it possible to give the wheel the correct form. This fixture is secured to the emery wheel at the back and is so placed as to bring the center of the swing

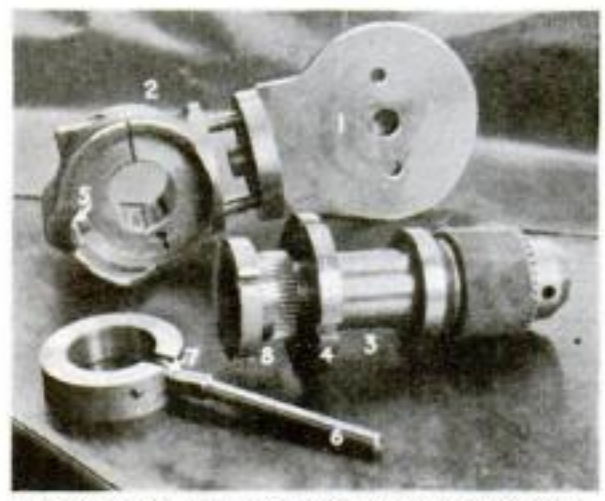


Fig. 3. The chucking and spacing device dismantled to show construction of various parts.

of the diamond approximately over the center of the emery wheel. As the wheel wears away, the radius member may be lowered by means of the screw support *K*.

The diamond may be set by micrometer adjustment with the knurled nuts *bb*. The yoke *L* is manipulated by hand with the handle *M*. The disk *N* strikes against pins and limits this motion.

The flutes of the tap are placed in the proper relation to the grinding wheel by means of the locating bar *O*, which is shown in its vertical position clear of the grinding wheel. This bar is also adjustable by means of micrometer nuts.

Details of the swiveling head member are shown in Fig. 3. Part *1* is set on the swivel point of the table and has bolted to it part *2*. The spindle *3* has a tapered hole to receive either the chuck or the center drive support. A disk *4*, with the required number of index slots, is placed on the spindle as shown. The index slots are tapered in form, having one side parallel to the spindle axis to insure the correct angular position of the work. The flipper pin *5* can be seen in the housing *2*.

Indexing is accomplished with the swinging lever *6*, which has a pawl *7* that engages with the ratchet of *8*. When all members are assembled, the ring rides free on *8* and is kept in place by the shoulder. The slots in the shoulder serve for the application of a spanner wrench.

Details of the truing device for center work are shown in Fig. 4. This is made dust proof by means of two felt collars, one being placed at *A* and the other around collar *B*, which is within C^1 when the fixture is assembled.

The endwise adjustment of the dia-

A definite program for getting ahead financially will be found on page four of this issue.

mond is made by means of the threaded end of the main member *C* and the collar *B*. With the adjustment made, *B* is locked with the wedging member *D* and forces the two lugs *E* outward against the internal threads of *B*. These lugs are carried in holes as at *F*.

Other details are shown as *1*, *2*, and *3* in Fig. 4. Part *1* is one of the several clapper-blocks used in the construction. These

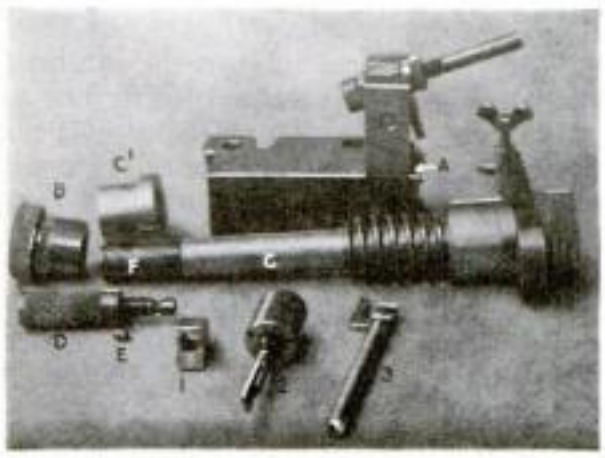


Fig. 4. The wheel-truing attachment, one of the clapper blocks, the cutter, and the locating bar.

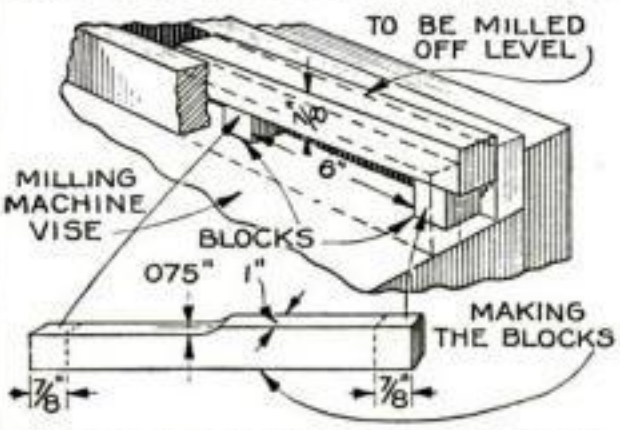
blocks have holes 3/8 in. in diameter and 1 in. long, which are supplied with 1/16-in. keyways. The blocks must be made accurately and the keyways should be good fits. The cutter *2*, which was made for doing the splining, is of special interest.

Member *3* is the locating bar *O* in Fig. 2. It is cut as a micrometer screw and has a keyway cut along its entire length to supply a means of keeping it in position and free from the slightest circular movement.

Tapered Keys Accurately Machined in the Miller

TAPERED keys can be machined quickly and accurately in the milling machine if they are held at the proper angle in the miller vise by the use of small blocks.

For purposes of illustration, let us say that the taper figures .075 in. in every 6 7/8 in. Our blocks then must have a difference in height of .075 and must be placed so that any two corresponding points on



How the two blocks are used, and a quick method of shaping them in the milling machine.

the blocks are exactly 6 7/8 in. apart. If as in this case the blocks are cut 7/8 in. thick, the distance between the inside surfaces of the blocks will be exactly 6 in. The blocks can be quickly brought to shape in milling machine in the manner shown.

Placed as indicated, the blocks will give the upper surface of the key stock a slope equal to the required taper, and all that is now necessary is to run the cutter across the surface.—W. S. GALLMAN.

Molding a Concrete Roller for Lawns

By P. P. B. BROOKS

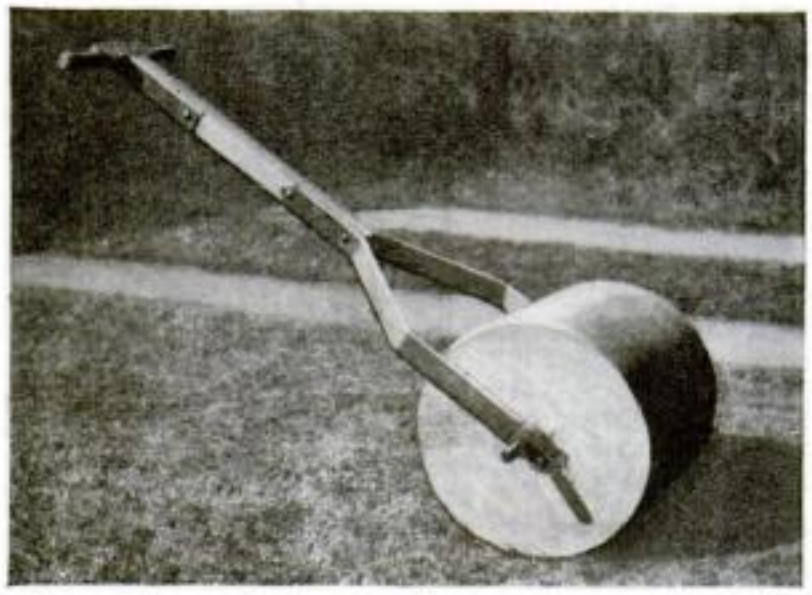


Fig. 1. The completed 18 in. diameter concrete garden roller weighs approximately 400 lb., allowing for the shaft and handle.

FEW tools and supplies are needed in the construction of the serviceable concrete lawn roller shown in Fig. 1. The roller as made by the writer is 18 in. long by 18 in. in diameter and weighs approximately 400 lb., allowing for the shaft and handle.

The molding form, constructed of sheet iron and wood, is illustrated in Fig. 3. The wooden end pieces for the form are shown in Fig. 4. The bottom consists of a wooden platform with cleats cut to fit in an 18 in diameter circle and placed so as to hold the sheet iron cylinder. The top is also cut to fit the cylinder and has a crosspiece to support the shaft. Holes for the shaft should be carefully centered in both the base and the top.

At the tinner's, obtain a piece of sheet iron 18 in. wide and long enough to lap over at least 6 in. at the ends when it is bent into a circle of the desired diameter (an 18 in. diameter circle has a circumference of approximately 56½ in.). This cylinder is then placed between the end pieces and the form trued up and braced, as shown in Fig. 3.

To prevent the sheet iron from bulging in the middle, three strands of wire should be placed around it as shown. These are tied loosely at first and then each wire is tightened after the concrete is poured above its level.

The shaft should not be less than 1 in. in diameter and should project beyond each end of the roller about 2 in. An old Ford axle is excellent, but if it is to be cut to length, the cutting should be done before the roller is made. The cutting is tedious work with a hack saw, but can be accomplished easier if the temper is drawn first.

For the concrete, a 1:2:4 mixture is satisfactory; that is, 1 cu. ft. of cement to 2 cu. ft. of sand and 4 cu. ft. of crushed rock or screened gravel. The largest pieces of rock or gravel should not exceed 1½ in. across. Tables of concrete data show that a 1:2:4 mixture yields about 4½ cu. ft. of concrete for each cubic foot of cement. Similarly it yields 4½ cu. in. of concrete for each cubic inch of cement.

The volume of the roller is approximately 4,581 cu. in. Calculating, we find that 1,018 cu. in. of cement are required with 2,036 cu. in. of sand and 4,072 cu. in. of gravel. These volumes, of course, will be measured approximately, using a tin can or bucket whose volume can be estimated to within a few cubic inches. The more accurate the measurements, the less the loss of time, labor, and materials.

The sand should be spread evenly on the mixing floor, which may be a wooden platform or a concrete garage floor. The cement is then spread over the sand and mixed in with a shovel or a hoe until the mass has assumed a uniform gray color. The gravel is then added and mixed in thoroughly.

When a uniform mixture is obtained, the whole is spread out and wetted down with a garden sprinkler. Be careful not to add more water than the mixture will absorb. Another mixing follows, and water is added a little at a time until a mass of slightly thinner consistency than what is known as "quaky," though not quite "sloppy," is obtained. The importance of thorough mixing cannot be overemphasized.

Pour the concrete into the form at once. Nothing is better for this purpose than a small coal scuttle. After adding each scuttleful, work the mixture with a rod or a garden trowel to compact the mass, to remove air bubbles, and to bring the mixture into close contact with the form. A garden trowel is especially good for this purpose because it can be worked close to the curved form, shoving the larger particles toward the center, thus allowing the sand and cement to produce a smooth surface. If possible, allow the roller to cure in the form from 2 to 4 weeks.

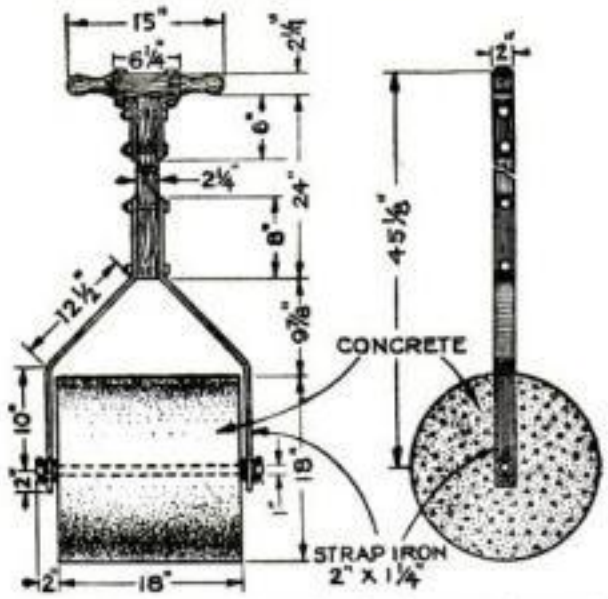


Fig. 2. The concrete cylinder has a volume of about 4,581 cu. in. Note handle construction.

If the amount of sand seems to be considerably in excess of the amount needed to fill the voids in the gravel, increase the amount of cement. A reasonable increase of cement will also serve to give early strength, so that the form can be removed sooner. A mixture of one part of cement to 3½ parts of bank run gravel which contained an excess of sand was used for the roller which illustrates this article.

Figure 2 shows the assembly of roller and handle. The straps, made from 2 by ¼ in. steel, are held in place on the shaft by washers and cotter pins and are bolted to the wooden handle, which is 2¼ by 2 in. and should be from 24 in. to 30 in. in length, to suit the convenience of the user.

A heavier roller can be made by varying the circumference and length of the mold for the concrete cylinder.

Fig. 3. The form consists of a cylinder of sheet tin held to shape by a wooden top and bottom, which are braced as shown. A brace across top holds shaft central.

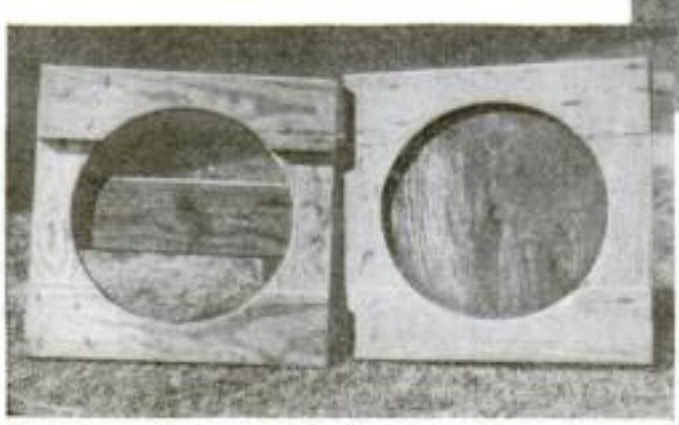


Fig. 4. The toppiece (shown at the left) is open and has the brace which holds the steel shaft, while the bottom piece (shown at the right) is solid in construction and also has a hole to receive the shaft.

What Our $10,000 Prize Will Do for Science

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A somewhat similar stand was taken by Dr. W. W. Coblentz, formerly physicist of the United States Bureau of Standards, Washington, D. C., whose comment was as follows:

"I regard the estimation of 'achievement in science of the greatest potential value,' during the year, as purely relative. The following year it may not appear so promising."

However, unqualified approval came from Ralph Modjeski, noted builder of bridges, and recipient this year of the John Fritz medal for distinguished achievement in engineering. Mr. Modjeski wrote:

"I consider that your creation of an annual award will be a great stimulus to all men of science. It is a most praiseworthy and public-spirited action on the part of your publication."

An interesting point of view is that of Dr. Lee De Forest, radio pioneer and inventor of the audion tube:

"We older scientists look forward eagerly to those who will take our places. That they may be duly rewarded for foregoing the more remunerative business world to devote their lives to science, we are grateful to such agencies as POPULAR SCIENCE MONTHLY. Through the far-sighted vision of such organizations as yours, science has come to be looked upon not only as a future benefactor of mankind, but as a great worker in modern life, to be paid for in the present."

CORDIAL commendation of the award and the motivating idea in back of it was expressed by Dr. William Bowie, engineer and geodesist and Chief of the Division of Geodesy of the United States Coast and Geodetic Survey.

"The award," wrote Dr. Bowie, "should lead to greater support of science and a better remuneration to the scientific workers and, therefore, the scientific men of the country cannot but look with great favor and commendation on the forward step that has been taken by your journal."

Equally enthusiastic were men prominent in such widely divergent fields as Admiral W. S. Benson, formerly Chief of Naval Operations; Major General William R. Smith, Superintendent of the United States Military Academy, West Point, N. Y.; and Dr. Carleton R. Ball, until recently principal agronomist in charge of the Bureau of Plant Industry of the United States Department of Agriculture.

"I cannot tell you how wonderful and fine I think your generous offer is," was Admiral Benson's comment. "POPULAR SCIENCE MONTHLY in offering this generous reward for research work is placing the entire world in its debt."

General Smith sent this message: "Since its founding in 1872, POPULAR SCIENCE MONTHLY has contributed immensely towards the advancement and understanding of science, and has thus indirectly increased beyond the power of measurement the mental and physical comforts of living. It now proposes to encourage scientific accomplishment for the benefit of all mankind by the direct specific award of an annual prize of $10,000 for notable achievement in science. Not only is this generous award highly appropriate as a recognition of past achievement, but it also places in the hands of the recipient funds which may be sorely needed in many instances to continue the work of skilled hands and active brains."

And Dr. Ball wrote:

"Scientific research, unselfish in its zeal, has brought rich blessings to humanity but too often has not freed its followers from financial care. This award for outstanding results is in line with the modern trend and the climax of all such benevolent efforts."

Several commentators had interesting suggestions regarding the award. Dr. William Dyane, professor of (Continued on page 138)

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(*Continued from page 137*)

bio-physics in Harvard University, proposed extending the time of work eligible for the award to ten years previous, and also declared:

"The award should not be given for anything that is patented or is to be patented, for such achievements bring their own financial reward."

Prof. T. J. J. See, Mare Island, Calif., astronomer, points out the difficulty of making a satisfactory award:

"I beg to say that from the established history of science in former ages no committee, however eminent, can really pick out the greatest potential discovery to mankind. I wish you very good success in the difficult task and can only forecast success if you do not allow common opinion to run it."

THESE difficulties are again emphasized by Dr. Ales Hrdlicka, curator of the Division of Physical Anthropology of the United States National Museum, Washington, D. C., who thinks the judges will face a difficult problem in selecting the prize-winning achievement.

"What are to be the main criteria of their judgment," he asks, "and how can they manage to be impartial to all branches of science? Will not the more spectacular 'achievements,' and those in the physical and chemical lines, have an undue advantage over those that are less spectacular, or have less backing and popular appeal?"

This view is not shared by former President Calvin Coolidge, who wrote:

"I note the very distinguished committee that has been chosen to administer this fund and I feel sure it will result in a very fine public service. I wish to express my commendation of your efforts and my best wishes for your complete success."

Confidence in the committee's ability to make a wise and impartial decision is expressed by several other men of note. Dr. Walter S. Adams, director of the Mount Wilson Observatory at Pasadena, Calif., comments:

"I am especially glad that the membership of your Committee of Award insures that decisions will be made on the basis of broad and far-reaching considerations, and so avoids restriction to purely practical invention."

"The names that appear on the list of the Committee of Award," wrote Dr. Josiah H. Penniman, the distinguished provost of the University of Pennsylvania, "are such as to insure a wise selection of the winner. The spirit of this award is that of the founders of POPULAR SCIENCE MONTHLY and perpetuates the spirit of Benjamin Franklin, who established the American Philosophical Society for 'the promotion of useful knowledge.'"

In his message of congratulation, Governor Arthur J. Weaver, of Nebraska, said:

"The committee of distinguished scientists who are to determine the award is a guarantee of complete fairness and high intelligence in making the award, difficult as it may well be, in determining the future usefulness of an idea or invention."

AND Dr. Parke R. Kolbe, president of the Polytechnic Institute of Brooklyn, N. Y., expressed himself in these words:

"You have assembled a distinguished Committee of Award and I am sure that only good can come through the encouragement which you are thus conferring on the scientific workers of the country."

While endorsing the creation of the award as a desirable means of recognizing excellence in scientific work, Dr. James R. Angell, president of Yale University, expressed doubt of its ability to stimulate investigators and inventors to greater activity. He said:

"I have always (*Continued on page 139*)

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(Continued from page 138)

doubted whether financial prizes really exercised any very stimulating effect on the more creative types of mind. At the same time, I am much interested in the proposed annual award."

A similar comment was that of Dr. Virginia C. Gildersleeve, dean of Barnard College:

"It is pleasant to think that a distinguished scientist should receive this large sum of money, but I rather doubt whether the existence of the prize will stimulate invention and discovery. Somehow prizes do not seem to work this way."

But many other educators voiced unqualified enthusiasm for the step POPULAR SCIENCE MONTHLY has taken and the beneficial results expected from it.

DR. W. M. LEWIS, president of Lafayette College, wrote: "The amount of the award and the breadth of its scope will undoubtedly stimulate much scientific effort of constructive value. In providing this award and promoting the plan, you are rendering service of outstanding value."

Dr. George B. Cutten, president of Colgate University, approved of the prize in this fashion:

"The annual award seems to me to be a definite forward step and should prove to be an incentive to a great many men."

One answer to the question of how the award may stimulate creative work in science is that of Dr. J. C. Futrall, president of the University of Arkansas:

"Knowing scientists as I do, I believe that many of them will value the medal more than the money and I am sure that much of the money award will be used by the winners for additional scientific research."

"A notable event in American scientific progress" is the manner in which Dr. Edward C. Elliott, president of Purdue University, characterized the institution of the award.

The pros and cons of a single award are discussed by several writers. Dr. Gustavus A. Eisen, former curator of the California Academy of Sciences, approves the spirit of the award but comments:

"It would in my opinion have been better to establish twenty awards of $500 each."

The opposite view is expressed by Dr. D. W. Morehouse, president of Drake University:

"I approve most heartily of the annual award. Its particular appeal lies in the fact that it is of sufficient value to lend great dignity to the enterprise. POPULAR SCIENCE MONTHLY enjoys such a reputation that those who do not win the monetary goal will be more than justified by the publication of their work or the recognition of their efforts."

DR. JULIAN A. BURRUSS, president of Virginia Polytechnic Institute, drew upon his personal experience as a scientific investigator and educator when he wrote:

"Having been for many years directly interested in scientific research and particularly in the dissemination of the results of such research and their practical application, I am naturally delighted to learn of the annual award which POPULAR SCIENCE MONTHLY has created. This is an outstanding act."

Dr. George H. Denny, president of the University of Alabama, emphasized the fact that the creation of the award is a logical development of POPULAR SCIENCE MONTHLY'S time-tested policy of encouraging scientific and inventive activity.

"POPULAR SCIENCE MONTHLY" wrote Dr. Denny, "has habitually encouraged scientific and inventive effort. Undoubtedly the creation of the $10,000 annual award for the year's achievement in science that shall be adjudged of greatest potential benefit to mankind will serve as a (Continued on page 140)

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tremendous stimulus to scientific and inventive activity."

"The growth and development of our country has been due to scientific investigation and discovery, plus American energy and courage," was the comment of Dr. J. A. C. Chandler, president of the College of William and Mary. "I am, therefore, delighted to see that it is the plan of your publication to encourage scientific research annually."

And Dr. Kenneth G. Matheson, president of Drexel Institute, Philadelphia, Pa., said:

"This action on the part of your periodical will create a concrete interest in scientific achievement which in my judgment will be far reaching in fruitful results."

Other prominent persons commented as follows:

Governor John S. Fisher of Pennsylvania:

"The magazine has always kept abreast of the times, and has been a tremendous agency in the spread of scientific knowledge. This last step is most liberal and cannot fail to do much for the stimulation of activities which will yield great benefits to mankind. I most heartily congratulate you on your progressive action."

SURGEON General Hugh S. Cumming, United States Public Health Service:

"The action of POPULAR SCIENCE MONTHLY is splendid, the selection of the committee beyond criticism, and now we trust that American research will continue to produce work worthy of high recognition."

Rev. Dr. S. Parkes Cadman, pastor of Central Congregational Church, Brooklyn, N. Y.:

"The terms of the award are sagacious and far reaching. We surely need the best results of scientific investigation applied to the actual needs of society, and your munificence will stimulate progress in this direction."

Frederick H. Ecker, president, Metropolitan Life Insurance Company, New York:

"An award like this, not only in its intrinsic value, but also in the distinction which will accompany it, must surely serve to stimulate scientific experiment and development."

Governor A. W. Norblad of Oregon:

"I want to congratulate you upon this real service to America."

Jane Addams, distinguished sociologist, political reformer, and author:

"I am very grateful for any effort which brings scientific achievement more clearly before the public and which encourages a better understanding of what is constantly happening in the world of scholars."

Governor Frank G. Allen of Massachusetts:

"I am confident that this annual award will effectively advance both science and invention."

Roy W. Howard, chairman of the Board of Directors, Scripps-Howard newspapers:

"The honor that goes with the gift of money is in itself worthy of the best efforts of that great body of men and women who are devoting their lives to human advancement. The $10,000 is by no means to be brushed aside, however, I understand it to be the largest single monetary prize in America for scientific accomplishment."

GOVERNOR Frank C. Emerson of Wyoming: "It is a pleasure to commend the project of the $10,000 annual award by POPULAR SCIENCE MONTHLY for the most valuable achievement in science."

Dr. A. T. Poffenberger, professor of psychology in Columbia University:

"If in 1872, when POPULAR SCIENCE MONTHLY was founded, it was considered important to diffuse science, it is a thousand times more important to humanize scientific knowledge today. The

(Continued on page 141)

What Our $10,000 Prize Will Do for Science

(Continued from page 140)

annual award announced by POPULAR SCIENCE MONTHLY will be one effective means of giving scientific work and the scientific workers the attention they deserve."

George B. Cortelyou, president of the Consolidated Gas Company of New York:

"POPULAR SCIENCE MONTHLY has done a notable thing in instituting this annual award. It will not only focus public attention upon scientists by rewarding the individual scientist but will provide the stimulus of enhanced public appreciation of their invaluable services."

Governor F. B. Balzar of Nevada:

"This is an offer of vast magnitude and should result in arousing a high degree of enthusiasm in making advancement in the scientific world. The personnel of the committee as named is, in itself, a guarantee that the utmost fairness and justice will prevail in making awards."

Rev. Dr. John Haynes Holmes, pastor of The Community Church of New York:

"Your announcement of an annual $10,000 prize for each year's greatest achievement in science is a thrilling thing. Your prize should do in this country what the Nobel Prize does in the world at large."

ALEXANDER KLEMIN, professor of aeronautics, New York University:

"I believe this award will be of great value in furthering the progress of American scientific work both pure and applied."

Frederick A. Kolster, radio research engineer:

"The creation by POPULAR SCIENCE MONTHLY of this annual award merits the highest commendation."

M. M. O'Shaughnessy, city engineer, San Francisco:

"I believe it will have a fine tendency in promoting scientific advancement."

Dr. George L. Omwake, president, Ursinus College:

"I believe in awards of this kind in college and in the larger realm of human achievement in the outside world as well."

Modern Hotel Is a Huge Machine

(Continued from page 23)

Lewis called it, required special apparatus. Elevators level themselves automatically at the proper floors and doors swing open of their own accord. When a guest pushes a "down" button on the fourth floor, for example, the next elevator coming down automatically stops for him; the elevator operator has nothing to do with it. But if the dispatcher in the lobby sees from the number of stops revealed by a light indicator that one elevator is probably filled, he can speed up traffic by a master control. It countermands the automatic devices and lets an elevator go by a normal stop. The dispatcher can talk by telephone with an operator, no matter where the elevator may be. The cars rise 700 feet a minute.

On the thirty-ninth floor of the hotel, higher up than any other in the world, is the telephone exchange, with ninety-five operators. But phones are not the only means of communication. A pneumatic tube, for instance, speeds the bill for your last minute telephone call downstairs so fast that it is waiting for you when you check out. Then there's the telautograph, the device that reproduces handwriting at a distance—there's one in Lewis's office—to give written records of every request for repairs.

Every guest room has a radio. On the forty-first floor we saw the (Continued on page 142)

Modern Hotel Is a Huge Machine

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radio room. It might have been a large commercial receiving station. These "five are broadcast receivers," explained Lewis. "The sixth is a powerful short-wave set to pick up European programs." An operator sat at a panel longer than the room was high. He was operating the sixteen power amplifiers. In all, the room contained a hundred big radio tubes. In case an SOS should interrupt the radio programs, and the broadcasting stations be shut down to clear the way for a ship's distress signals, two electric phonographs stand ready to fill in.

"Four of the receivers give the guest a choice of as many programs in his room," Lewis said. "Separate feeder lines run from each to every room—more than ten miles of wire in all. Another receiver gives radio programs through a public address system in the public rooms. In the banquet hall we have a unique device—an 'echo sound projector' that gives music just loud enough to be heard, yet not to disturb conversation. It is the first time this has been applied in such a large hall."

THE radio system had other innovations. The management could cut in on a program at any time to make important announcements to guests, either in their rooms or in the public halls. The hotel has leased land wires by which special events can be received and relayed to the rooms or public halls. "Annunciators," proudly installed a century ago by the Tremont Hotel in Boston, were the forerunners of this modern mode of hotel communication.

"Now I'll show you where all our engineering services come out," Lewis said. He opened the door of a guest room, and we entered an inviting chamber furnished for two with a shower and bathroom adjoining. A modern, inclosed radiator was under the window. "One incident will give you an idea of the job of furnishing these rooms," Lewis said. "Every one, according to hotel custom, must have a Bible. The New York Bible Society, which furnishes those for New York, delivered our order for 2,500 about ten days too late. In the meantime about a dozen guests had called up the office to ask where their Bibles were."

I noticed the radio, a fifteen-inch cone speaker, in a corner. A switch allows the guest to make his choice of the four programs. There is even an automatic time switch to tune the radio to any desired program at a given hour. "The walls are soundproof," Lewis explained. "Your neighbor's radio won't disturb you. And the maximum volume is controlled from the central receiving station."

THE guest rooms, of course, were no less carefully engineered than the rest of the hotel. A compartment built into the entrance door allows a valet to deliver clothes without disturbing the occupant. As an outer door shuts, it operates a signal. The inner door can then be opened, and thus privacy is assured. Running ice water and other comforts are provided.

"What do you imagine pleases the guests most?" Lewis asked. After my tour of bewildering wonders I hesitated. The engineer smiled and pointed to a shiny metal gadget on the wall. "That little twenty-five-cent bottle opener and corkscrew, combined, makes more of a hit, if you'll believe it, than some of our most ambitious engineering schemes. They think it's wonderful, and ask where they can buy one like it or whether they can have an extra one as a souvenir. That's human nature, I guess. The average man, when he turns on a light or opens a radiator valve, doesn't think of the power plant below that supplies him light and heat. There's far more to running a hotel than one ever sees in a guest room."

Here Are Correct Answers to Questions on Page 46

1. Water cannot be siphoned above the height to which it can be pushed by atmospheric pressure. As atmospheric pressure at sea level is approximately sixteen pounds per square inch, and a column of water thirty-two feet high weighs sixteen pounds per square inch, this height represents the theoretical limit. Atmospheric pressure at a height above sea level of 1,000 feet is less than sixteen pounds, so that in this particular problem the water could not be siphoned to an elevation even approaching thirty-two feet and it would, therefore, be impossible to siphon it over an elevation 2,000 feet above the original water level.

2. The pull of gravity on any object is always the same, whether the object is surrounded by air at atmospheric pressure or is in a vacuum. However, an object weighed in a vacuum always is heavier than an object weighed in air at atmospheric pressure, because the object in the vacuum is not buoyed up by the air which it displaces. An object weighed when immersed in water may even have no apparent weight if the weight of the water it displaces is greater than the object's weight in air.

3. The depth of the water, provided it is deep enough not to interfere with free swimming, has no effect on the swimmer. It is easier to swim in salt water than in fresh water because salt water is denser and therefore heavier than fresh water. Consequently the body of the swimmer displaces a greater weight in salt water than in fresh water.

4. The horsepower of any type of engine is commonly measured either by means of the Prony brake or by using the engine's power to operate a generator of electricity and then measuring the output in electric current. The Prony brake consists of an adjustable friction device which can be attached to the shaft, and this friction device is rigidly fastened to an arm, the end of which is attached to a spring balance. The pull registered on the balance is figured with the speed at which the shaft is turning. When a generator is used the output of the generator is measured in thousands of watts and the result is divided by 746, as 746 watts is equivalent to one horsepower.

5. Water boils at 212 degrees only at atmospheric pressure at sea level. In a hot water heating system the weight of the water in the pipes and radiators on the upper floor produces a pressure considerably above atmospheric in the boiler, so that it is quite possible for the thermometer to read 220 degrees without any steam being produced.

6. Sound travels in air at a speed slightly less than 1,100 feet per second under average conditions. A close approximation of the distance in feet from the listener to the source of sound can be obtained in the case of a steam whistle, for instance, by timing the interval between the first appearance of the steam from the whistle and the arrival of the sound, and multiplying the result by 1,075.

7. The energy lost in friction in any piece of machinery is dissipated in the form of heat because friction always produces the equivalent of the wasted power in heat.

8. There is no known substance except iron, and to a very slight extent nickel and cobalt, that will have any effect on the pull of a permanent or electromagnet for a piece of iron.

9. The difference in the brilliancy or sparkle of a diamond and that of a piece of glass cut in exactly the same shape is due to the difference in the way they refract light. The brilliancy of diamonds is caused by the reflection of the light from many tiny (Continued on page 144)

Here Are Correct Answers to Questions on Page 46

(*Continued from page 143*)

faces before it escapes to the eye. When light strikes the surface of any transparent substance it is either reflected from the surface or penetrates through the substance, depending upon the angle at which it strikes. The critical angle for crown glass is about forty-two degrees. The angle for flint glass is thirty-six degrees, and for diamonds about twenty-three degrees. The angles of the faces on the diamond are so calculated that light, once it gets inside the surface of the diamond, is reflected back and forth from one surface to another instead of passing out through the back faces. A similarly cut piece of glass would allow a considerable amount of the light to pass out through the faces on the back and hence it would appear less brilliant.

10. A fireless cooker is simply a very carefully heat-insulated chamber into which the vessel containing the food can be placed after it has reached the boiling point. Because of the excellent heat insulation, the temperature of the material in the vessel drops very slowly from the boiling point, and, of course, cooking proceeds for a considerable time since most foods cook at a temperature lower than boiling.

Here Are Answers to Test Appearing on Page 60

The correct word to use in each case in the test given on page 60 is as follows:

1. eaten, given
2. bring, take
3. have, did
4. two, too, to
5. among, between
6. them, us
7. is, his
8. fiercely, pretty
9. set, lay
10. is, his, himself
11. doesn't, choose
12. were, was
13. it's, its
14. has, its
15. as, like
16. might, to
17. is, its
18. has, its
19. lay, lying
20. into, taller
21. have, is
22. let, laid
23. may, may
24. hopes, his
25. sternly, poorly
26. whom, who
27. numbers, its
28. him, her
29. from, from
30. is, are
31. almost, well
32. there, her, me
33. they, who
34. his, may, my
35. was, its
36. shall, will

Tomb Found in Mongolia May Solve Greek Myth

THE Greeks believed that far to the north of them lived a weird people called the Hyperboreans, or "Dwellers behind the North Winds." Archeology has come forward to prove they were right.

A Russian explorer, Professor Peter Kozlov, has just discovered a remarkable tomb in the mountain passes of northern Mongolia, in which he found various significant objects, unspoiled by the dust of passing centuries. He believes that the tomb belonged to an Asiatic person of rank who lived more than 2,000 years ago.

The objects brought to light were carved figures of dragons and other animals, tapestries, carpets covered with hieroglyphs, and pieces of jade. All of them showed the influence of two cultures, the Chinese and the Greek. Probably Greek ideas were somehow carried to the strange people far away in northern Asia, and vice versa. But if so, the contact between the races was so vague and uncertain that the Greeks always regarded their northern friends as a myth. It is thought this may account for the growth of the legend of the "Dwellers behind the North Wind."

First Photo Took Eight Hours

(Continued from page 44)

indomitable "bulldog of Cormeilles," most of all, that the world owes its inestimable debt for practical photography.

His study concerned the chemical effects of light on various substances. He treated innumerable plates of glass, paper, copper, and silver, coating them with various varnishes and oils. He experimented with the silver chloride paper of Wedgwood and Davy. He tried the bituminized plates of Niepce. In the end, he found silver plates exposed to vapor of iodine most sensitive to light.

DURING his early experiments, Daguerre worked with Niepce. This retired soldier, who had fought with Napoleon in the Italian Campaign, had made a crude camera, before 1825, using a cigar box and a lens taken from a telescope which had belonged to his grandfather. His plate was made by coating glass with asphalt dissolved in oil of lavender. Pointing the camera out of his window at a pigeon house, he exposed the plate for eight hours. When he applied solvent to it, the dim outlines of the latent image became visible—the first permanent photograph of history.

Niepce called his process "sun sketching." When he died in 1833, he had improved his process very little and apparently had given up hope for the success of practical photography. But Daguerre labored on, month after month, for six years more, until with success assured, he was able to show his Daguerreotypes to the world.

Even then, people were skeptical. When he tried to form a stock company the Parisian public jeered and refused to buy a single share. In desperation, he took a chance, showed his pictures, and explained the secret process by which they were obtained to the eminent French physicist, Arage, who gave his endorsement. As a result, the French government awarded Daguerre a life pension of 6,000 francs a year on the condition that his invention should be given to the world and not patented. Once again, the affairs of this remarkable man were at the flood. Hundreds of distinguished men visited his studio and sought to learn his process.

ONE of these was Samuel F. B. Morse, later the inventor of the telegraph, who first introduced the Daguerreotype in the United States. It is easy to understand the strained, unhappy look of the early "tintype" portraits when it is realized that they had to be taken with the sitter's face covered with white powder, and with the exposure, frequently lasting half an hour, made in bright sunlight. Professor John Draper, another early American Daguerreotyper, introduced a popular innovation. Above the sitter, he placed a tank of clear blue ammonia copper sulphate to lessen the painful glare.

For only a decade, from 1839 to 1849, the "tintype" held sway. Delicate, so that the merest touch often marred its beauty, tarnishing rapidly when exposed to the air, it soon gave way to improved methods of picture taking. Some of the early silver-coated plates cost as much as forty dollars apiece.

No one knows the number of cameras used for pleasure in the world today. Photography has become an inseparable part of present-day life. The last available statistics show that in one year $72,000,000 worth of photographic equipment was produced in the United States. In motion and talking pictures, it provides relaxation for millions. In the hands of science, it aids in virtually every branch of research. In medicine, it has combined with the X-ray to relieve human suffering.

In later years, Daguerre suffered from ill health, worn out by his long battle. He died suddenly in 1851, at the age of sixty-three.

I've Seen a Lot of Flying in Twenty Years

(*Continued from page 59*)

allow greater protection for the pilot as well as superior streamlining, tractors, with propellers and motors in front, have supplanted the pushers. Motors and gasoline tanks are still placed close together on many ships, increasing the fire hazard in a crash. This is something pilots would like to see designers change.

I have flown with many kinds of motors. Each had a sound of its own. I can close my eyes and hear the characteristic song of half a dozen engines: the clatter of the Anzani, the whine of the Gnome, the thunder of the Benz, the howl of the LeRhone, the staccato volley of a Challenger, and the smooth, deep-seated roar of a Whirlwind. Since the war, air-cooled motors have achieved supremacy. They have proved as reliable as water-cooled engines, are lighter per horsepower, and have no water-cooling system to get out of order.

THE French Gnome was the Wright Whirlwind of 1911. It held practically all the records. This curious motor was air-cooled and spun around with the propeller. It was lubricated with castor oil. In a Bleriot, the excess oil shot back, hitting the pilot in the face. Frequently we came down from the clouds covered with castor oil. When it got in our eyes, they pained for hours. Another eccentricity of the Gnome was its sticking valves. If the engine got hot, the spring on the intake valve would lose its elasticity and the valve would stick. If a rocker arm on one of these whirling engines broke, the ship came down with its cowling torn to pieces.

The gyroscopic effect of these spinning motors had to be watched on early planes. In 1912, Weymann represented America in the Gordon Bennett Cup Race. He flew a 100-horsepower Gnome-Nieuport. Spectators saw his left wing dip several inches every time he cut the engine in and out on a turn.

I once saw a freak accident happen to a mechanic who was cranking a Gnome on an old Farman pusher. The pilot shoved the throttle clear ahead by mistake. The motor started with a roar. It tore the machine out of the hands of those who were supposed to hold it. The tail struck the mechanic from behind. He rolled a dozen yards like a batted ball before he could find his feet.

TWENTY years ago, when flying was just beginning, the papers were full of wild stories of the imagined adventures of noted skymen. In those days there were a dozen flights of imagination for one of an airplane. But I used to believe every one. I swallowed them whole. I remember two. One told how Vedrines, the idol of France, had been attacked by a giant golden eagle high over the Pyrenees during the Paris-Madrid race of 1911. According to the account, he battled for his life, his frail Deperdussin monoplane rocking from side to side as, with a small penknife, he fought off the infuriated bird. The other told how André Beaumont, the famous Bleriot pilot, almost lost an eyelid. According to the story, a plane swooped close above him in the air, and as he looked up, a gale of wind caught under an eyelid, puffing it up like a miniature balloon. He thought it would be torn off before he could lower his head—anyway, that's what the published report said.

Such tales were more creditable in those days than now. There were no windshields and pilots sat exposed to a gale of wind. Frequently they wore no goggles. On my first Farman, I was perched precariously on a sort of ladder stuck out in front of the lower wing. During the first flights, I remember, the wind pushed back my cheeks. I felt I was grinning all the time I was in the air. Later, I seemed to develop muscles to

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counteract this pressure. Every once in a while the pilot of a Farman or a Voisin would have his cap blown off. It would sail back into the propeller, and the machine would come down with a broken blade. Once a long scarf, worn by a Bleriot pilot, blew off, caught in the rear control wires, and caused a crash.

The contrast between those flying conditions and the comfort and safety of a modern amphibian, able to come down on land or water, marks twenty years advance. It is a far cry from one of the new ships to the clattering biplane, with a red canoe tied underneath, in which Wilbur Wright flew above the Hudson River from Governor's Island to Grant's Tomb and back, twenty-one years ago.

WE FOLLOWED rivers on night flights during the war. When the ground was inky black, the water usually reflected a little starlight that made it visible. In a forced landing, we planned to set the ship down in the water in a pancake landing to save it. Once I got lost on a night flight and found my way to the field by recognizing the silhouettes of mountains as I flew along. Several times I have had to set a ship down in a field on a mountain side with no other illumination than moonlight.

Those early experiences stood me in good stead about a year ago when I had to make a forced landing in pitch darkness. I was coming in from the end of Long Island. Strong headwinds held me back. Darkness closed in while I was miles from Curtiss Field. There was no moon. The night was black as a coal bin. I followed a dim, white thread, winding below—the ocean surf on the south shore.

Near Freeport, I picked up the field beacon and headed toward it. When I swung over the field, my gas tank was nearly dry. I had to come down at once. Quickly I released the single flare on the ship. The fuse sputtered. Then the field, the hangars, and the countryside were bathed in the most brilliant chemical light known to man. From 1,000 feet, I could see, in lights and shadows, ruts at the far end of the field and splotches of oil on the ground before the hangars. I circled the field, headed into the wind and put the ship into its glide. As I slid above the hangars, I caught a glimpse of a cluster of white dots before the "doghouse," the upturned faces of a dozen mechanics. Then everything went black. The flare had burned out prematurely. I couldn't see a foot in front of my nose. And the humming wires told me we were racing toward the ground.

WHEN a plane's distance from the ground is half the span of the main wings, a pilot with several thousand hours' experience can often feel a "cushioning" effect. The air "packs up" between the wings and the earth. I ballooned down, "feeling for the ground." At the first sensation of "cushioning," I leveled off. The ship touched on three points!

To protect a pilot from such an emergency, night flying planes are now always equipped with two flares. If one burns out or fails to operate, the other can be used. When we first began using parachute flares, the tube from which they were released was placed in the floor of the cockpit between the pilot's feet. We always carried a small stick handy. If the flare stuck, we poked it out with the stick. Three minutes is the usual length of time a modern flare burns. It gives off a light equal to between 300,000 and 400,000 candlepower. It is usually released at an altitude of 2,500 feet.

When the "Circuit of England" race was held in 1911, bonfires were lit along the course. The smoke guided the flyers by day and the blaze led belated racers to control points at dusk. Those bonfire beacons formed the beginning of the (Continued on page 148)

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lighted airways of today. Now a night flyer in America can follow a chain of flashing aerial lighthouses from coast to coast. There are more than ten thousand miles of lighted airways now in the United States.

In the dark, familiar landmarks are blotted out. Main highways can sometimes be distinguished by the stream of automobile headlights, visible from the air. A railway can be located by the glowing windows of passenger coaches or by the red glare on the smoke of the engine when the fire box door is opened. Steel mills throw up a lurid light on the sky that is visible for many miles. When the early night air mail pilots were blown off their course by storms in Ohio, they used to find their way to Cleveland by following the red patches on the sky above the steel mills of Sharon, Youngstown, and Warren.

ONE time, I arrived at an air field after dark. Under a cloud, near the edge of the field, the ship suddenly rocked and trembled. It had struck the backwash of another plane which had crossed ahead. We had just missed in the dark and neither pilot had seen the other. That was before riding lights—red on the left wing tip, green on the right wing tip, and white on the tail—were required on night-flying planes.

An even more thrilling escape from a collision at night was reported a little more than a year ago by one of the Pitcairn pilots. He hopped off from the Philadelphia field carrying the night air mail for Atlanta. It was a clear night with plenty of stars, but no moon. He was flying at 2,000 feet. Suddenly a gray shape loomed up ahead. At first he thought it was a small patch of cloud. At the last minute, he decided to climb over instead of flying through. He pulled back the stick, zoomed up, and when he looked down—caught his breath. Below floated the huge silver body of the Navy dirigible *Los Angeles*, returning from a training cruise. After that narrow escape, the Navy issued orders for the big airship to steer clear of the night air mail lanes.

The smallest ship I ever flew had an eight-horsepower motor. This gnat-sized baby plane landed at about twenty miles an hour. It seemed no faster than a walk after coming down for hot landings in Fokker and Nieuport pursuit planes. They often touched the ground going like greased bullets. The largest ship I've piloted had a total of a thousand horsepower. The steadiest ship I remember was an old Voisin. It was no more streamlined than a hayrack. The hundred wires that braced its wings would all vibrate in flight, each producing the resistance of a broom handle. The ship was too stable to be safe. It couldn't be maneuvered quickly enough. The most unstable plane I ever flew was the one I built myself just after I learned to fly in the Balkan War. Piloting it was like walking a tightrope in the wind.

WHEN I used to act as test pilot for a new machine, I never knew whether the ship would be a bird or a groundhog. To know if it would fly, you had to try and see. Now, wind tunnels and kindred tests show a design is aerodynamically correct before the plane is built. When it is turned over to the test pilot, he knows it will get off the ground. Fifteen years ago, designers didn't know the strength of various materials as they now do. Ships were built stronger than was necessary in some places and not strong enough in others. Each year, planes become stronger per pound of weight.

The other day I dove a Curtiss Hawk at almost 250 miles an hour in perfect safety. A few years ago, I saw a pilot try to do that and he washed off his wings. At that time I was up with a student (*Continued on page 149*)

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near Curtiss Field. Two Army pilots were stunting a thousand feet higher up. I was in a flipper turn, banked vertically to the ground, when I looked up. I saw the Army plane come down in a vertical dive. The pilot pulled out too abruptly and the wings broke. They jackknifed back along the fuselage and, like a yellow meteor, the plane shot past a couple of hundred yards away. I could see the men fighting to get free. A hundred feet below, they kicked loose. I began to breathe again when their parachutes blossomed and they floated down to safety.

When we first began using parachutes in planes, the jumper used to crawl down and hang by his hands from the axle of the landing gear. When he was ready to drop, he just let go.

PROBABLY the two greatest stunt flyers of the early days were Lincoln Beachey, the American, and Adolphe Pegoud, the Frenchman. The latter was the first man to fly upside down and to loop the loop. He was a temperamental artist of the sky. Before he would leave the ground to perform his loops, he always demanded a pint of red wine. He trained for his stunts by placing a monoplane upside down on tall wooden horses at the Bleriot factory. He strapped himself in the seat and hung head-downward for so many minutes each day. Gradually he increased the time until he could hang in this position for long periods without discomfort. Then he went up, made his first vertical letter S in the air, and became famous overnight.

The first plane I flew had no instruments at all. My latest ship has a dozen dials and gages on the instrument board. They make possible long and "blind" flights through fog. In ordinary flying, however, the instruments should be glanced at occasionally rather than watched constantly. "Bubble chasers," students who learn to fly by instruments alone, never make satisfactory pilots. After all, instruments show what is happening—after it has happened. Most flying should be done by "the feel of the ship."

Recently, a greenhorn pilot in Montana "cracked the throttle" for starting the motor and shoved it almost wide open. Without setting the brakes, he swung the propeller. The motor snorted, took hold, and the machine charged down the field, a runaway ship. According to newspaper accounts, it took off, flew for nearly five miles by itself, and came down in a large hayfield with no other damage than a broken propeller. Such a flight is entirely possible. Given half a chance, a modern ship will fly itself.

Twenty years ago, a plane wouldn't keep going a minute without a pilot. Early machines didn't want to fly. The pilot had to make them fly. In a nutshell, the difference between the planes of the past and those of the present is this: In the old days, you had to *fly* your plane; now you have only to *pilot* it.

Not long ago, I flew for nearly two hours on a cross-country trip with my hand off the stick. Most of the time, I leaned back on the cushions and looked out the cabin window at the scenery. Occasionally I would tap the stick to one side or the other with a forefinger.

That is the sort of flying we used to dream about—twenty years ago.

NEXT MONTH:—Jordanoff writes of stunt flying and explains why a pilot's life may depend upon his skill in performing aerial acrobatics. You will not want to miss this thrilling chapter from the life of a flyer who in war and peace has faced death hundreds of times.

Harbors for Motor Boats

(*Continued from page 57*)

A third plan would convert unused steamships into breakwaters for boat harbors. This plan is proposed by the New York Yacht Basin Association, an organization of motor boat owners. It would utilize several of the old ships of the U. S. Shipping Board Fleet which have lain idle at their anchors nearPeekskill, N. Y., since the war.

Several of these boats, according to Montagu Worthley, secretary of the Yacht Basin Association, could probably be purchased for as little as $30,000 apiece. They would provide the equivalent of a concrete breakwater costing millions of dollars. Three or four 350-foot hulks would be bought, stripped of their superstructure, loaded with rock ballast to their Plimsoll load line, and moored fore and aft to make breakwaters. One of them, meanwhile, might be used as a clubhouse; another would be a supply ship; and a third possibly a marine museum. The ships could be unballasted and towed away, say every other year, to scrape and repaint their bottoms. Despite its novel features, the plan is said to be practical and economical.

NEW YORK is not the only city with a motor boat problem. Boston, a popular boating center, lacks adequate parking places for boats. A plan suggested by the National Association of Engine and Boat Manufacturers, which would create a series of T-head docks in Pleasure Bay, is interesting because of its method of offsetting the seven-and-a-half-foot rise and fall of the tide. Within the T-shaped dock, boats would moor, not to the dock, but to a floating walk adjoining it that rises and falls while sliding collars hold it to anchoring piles. A hinged stairway leads to the dock. Such a method, of course, is applicable in New York or any other city where tide is a problem.

Memphis, where the Mississippi rises thirty-five feet from its low to its high level, has a unique boating center in a floating barge, and larger floating docks are proposed for the future.

Chicago has already partly completed one of the finest potential motor boat harbors in the world. An improvement of its water front by a long series of breakwaters and artificial islands will provide protected lagoons for sheltered boat basins. San Francisco, where the newly completed harbor of the St. Francis Yacht Club moors an imposing fleet of boats at its slips and wharves, also plans a municipal "aquatic park" with two huge breakwaters.

A modern system of T-head docks not only solved Miami's motor boat problem, but yielded that city a profit. In nine months this municipal basin paid the city $12,000. That experience is typical of other cities; for instance, Detroit, which owned a system of 105 boat wells somewhat similar to the improved ones it now plans, reported a profit for 1927 of more than $9,800.

In other words, caring for the 1,356,000 motor boats in the United States is not only a desirable but also a profitable venture. Forward looking cities are now providing up-to-date facilities for the spreading sport of motor boating.

Rheology, a New Science

RHEOLOGY is the science involved when you spread a brushful of paint on the garage door. It is the science of flow, so christened by a group of chemists and physicists who recently gathered at the United States Bureau of Standards in Washington to study the deforming and flowing action of paints, oils, lacquers, and other plastic substances. The outcome has been a new word for the dictionary—rheology—and the formation of a society by the same name.

How to Get Into Gliding

(*Continued from page 25*)

115 members and a waiting list of a hundred more. It is building its own gliders and has more than a thousand dollars in the bank.

Not long ago the United States Chamber of Commerce sent a bulletin to the 2,000 chambers in the country, urging them to help support the glider movement. Free factory space has been donated by the chamber at Dayton, Ohio, to a club which is building its training plane, and in Florida the Fernandina Glider Club was given help in getting started by the Chamber of Commerce of that city. In other parts of the United States, groups which have shown initiative have received boosts from local civic organizations.

One club, a group of high school boys at Sioux City, Iowa, received a fine new glider from an unexpected source. When the National Air Races at Cleveland, Ohio, took place last August, they brought a homemade machine to compete in the glider contests.

IT MADE the 1,000-mile trip on an auto trailer. Then, at the end of the first day, a hard landing "washed it out." Without complaint at their hard luck, they prepared for the long trip home. So impressed with their sportsmanship was W. J. Scripps, president of Gliders, Inc., that he presented them free of charge with a new training plane.

The United States Government recently came to the aid of another club. It granted the Tucson, Arizona, glider club permission to establish a gliding camp on a steep hillside within a Government reservation. Practically all of the leaders of the aircraft industry are behind the movement to foster interest in gliding. Among those who have recently taken an active part are: Charles L. Lawrance, inventor of the Wright "Whirlwind" engine; Anthony H. G. Fokker; C. S. "Casey" Jones, president of the Curtiss-Wright Flying Service; "Eddie" Rickenbacker, American Ace; Charles F. Kettering, of the General Motors Research Corporation; William B. Mayo, Chief Engineer of the Ford Motor Company; "Eddie" Stinson; Admiral W. A. Moffett; and Capt. L. M. Woolson, inventor of the Packard Diesel aircraft engine and one of the designers of the famous Liberty motor.

IN PLANNING a glider club, one of the first things to determine is a favorable spot for practice. Low, rolling hills, free from obstructions, with slopes facing all directions, so flights can be made into the wind no matter from which quarter it blows, are ideal for simple gliding. The hills should be between ten and 150 feet high. For beginners, only gentle slopes should be used. If these ideal conditions are not available, a slope facing the prevailing wind should be chosen. The hillside selected must not be too close to the opposite slope or the latter may shield the training hill, "killing" the wind. A valley a quarter of a mile wide in front of the slope is desirable.

Along the California coast where Bowlus has done his great flying, a west wind blows almost continually against the high seacoast. Dr. W. Klemperer, who holds the first glider pilot's license issued in Germany and who is now connected with the Goodyear-Zeppelin Company of Akron, Ohio, believes that a soaring flight down the California coast from San Francisco to Los Angeles is entirely possible. W. H. Bowlus declares that a motorless flight from coast to coast, depending entirely upon rising air currents, eventually will be made. POPULAR SCIENCE MONTHLY is now coöperating with New York University and the National Glider Association in making a survey of the area around New York City to select the most favorable site for the national glider meet next fall.

For ordinary primary (*Continued on page 153*)

How to Get Into Gliding

(Continued from page 152)

gliding, in which the machine "coasts downhill on air" a few feet above the ground and does not rise higher than its starting point, as does a light soaring ship, even a small hill will afford thrilling flights. In fact, the first flights are usually made by shockcord launchings from level ground. Only experienced pilots should attempt towed flights behind automobiles. Such places as ledges, quarries and precipices are too dangerous for starting spots.

The hill selected should have no brush or fences upon it and should be clear at its base. Many beginners have come to grief through sailing farther than they expected and sitting down upon a fence or a clump of bushes. Recently, when the members of a New York glider club tried out their new machine, *The Blue Bird*, Paul Snell, the pilot, made a beautiful flight and a fine landing. But the plane skidded into a barbed wire fence and was torn.

IT PAYS to take time to investigate all possible spots carefully before beginning actual flights. The University of Utah Motorless Aviation Club members, for instance, spent nearly six months looking around and preparing before their first ship, *The Papoose*, was taken out for trial. It sailed for nearly a mile across a valley and 117 flights were made with only one slight mishap.

Clubs with diverse backgrounds have taken up motorless flying. The A. B. C. Glider Club of Detroit, for example, grew out of the American Business Club, an organization of young business men. The Titan Glider Club, of the same city, consists of aeronautical students at the University of Detroit who build and fly gliders as part of their study of the principles of aerodynamics. A Cincinnati, Ohio, club is made up entirely of girls, and a second girls' organization is now building its own glider at Buffalo, New York. Another unique club, recently established at Kansas City, Kansas, is made up entirely of airplane pilots holding transport licenses, the highest issued in America. The youngest glider pilot in the world, probably, is little Danny Crawford, of Cleveland, Ohio. At four, he recently made a short solo hop under his father's guidance.

GLIDING is an all-year-round sport. This should be taken into consideration in planning a club and a practice site. Suitable housing for the machine near the gliding hill should be provided. Planes left in the open deteriorate and, even when tied and weighted down, are in danger of blowing away and being wrecked. At the University of Michigan, members of the glider club fly in zero weather and when heavy snow is falling. Their practice ground is a large conical hill a couple of miles north of Ann Arbor. When the wind is right, they can sail from the top clear across a stretch of marsh and land on another hillside.

Last summer "Bud" Dalton, one of the members, got away for a fine flight and soared above the swamp. Trying to reach a knoll beyond, he unconsciously flattened his glide. The plane lost flying speed. The air "went out from under him." The glider sat so hard the keel sank in the mud up to the pilot's seat.

Such accidents, which might prove serious in an airplane carrying explosive fuel, rarely mean more than a bump or a shaking up for the pilot of a light engineless ship. A gliding club which makes careful preparation and acquires standard equipment, enters a comparatively safe realm of thrilling sport and valuable experience.

Next month: "Riding the Winds." How soaring planes cover hundreds of miles and climb thousands of feet into the air. Fascinating facts about sailplanes and the pilots who fly them.

Your Car Is Pigeon-Toed

(*Continued from page 74*)

still more important, the wheels may be out of balance. And when they are, you can't always see it. They seem to run just like any other wheels."

"How do you make a test then?" Topham asked.

"You can test for both troubles at the same time," the garage man said. "Jack up one front wheel. Give it a spin and see if it runs true. Then let the wheel slow down. If it always stops at some definite point, you can be sure it's out of balance. The tires turned out these days are marked so that they should be put on in a certain way. They are purposely made out of balance, just enough to compensate for the weight of the valve stem. If you get 'em on right the wheel will balance. If you get 'em on wrong way round, the unbalance of the tire adds to the weight of the valve stem and then you're in for grief. Even if the car doesn't shimmy every time you hit a bump, it will have a tendency to wobble."

"But suppose that the wheel is out of balance even with the tire correctly installed?" objected Topham.

"THAT happens sometimes," Gus conceded. "The rim may be slightly out of balance or perhaps one spoke is just a little too heavy. In a case like that, take a little sheet lead and fasten it to the rim at the point that stops at the top. You should add just enough lead so that the wheel will stop at any point and will have no tendency to roll back and forth."

"And how can you fix the camber if that isn't right?" Topham asked.

"Usually the camber is all right unless the axle is bent. If the caster is wrong that's easily fixed by dropping the axle away from the spring and putting an iron wedge between the spring and the axle, with the thin edge of the wedge pointed forward."

"Well," said Topham, "if you have the wheels lined up and the job on the rear fixed, I think I'll run along. My neighbor has been kicking about his car shimmying. I'm going to hand him some of the dope about caster and camber and maybe he can fix it."

"He can if he knows what he is about," said Gus. "Better tell him, though, that the first thing to do is to find out if the wheels wobble and whether they're in balance or not. And, if he isn't a pretty good mechanic, you'd better tell him to bring the car down here."

Skull with Apelike Jaw May Be That of a Man

IF THE skull with an apelike jaw, found recently near Peking by Dr. Davidson Black, of the Peking Union Medical College, should prove to be that of a human being, evolutionists will have established a very valuable link in their theory of man's ascent from the monkey.

"If the report is correct," says Dr. J. W. Gidley, of the Smithsonian Institution, "the find is of great importance. It demonstrates that in the early stages of human development there was a type of man with a human cranium and a receding chin similar to that of the modern ape. Parts of such a skull, together with a jaw like that of a chimpanzee, were found at Piltdown, England, in 1911, and there has been a controversy ever since as to whether skull and jaw belonged to one and the same individual." A close comparison of the Piltdown skull with that of the recent discovery in China might establish definite facts about the features of our prehistoric ancestors.

How Air Camera Men Map Unseen Places

(Continued from page 43)

a ground survey that would require years to complete. So the county called for bids to map the country from the air, and the task was assigned to us.

Here was a section of land the entire width of Long Island and some twenty miles long. For economy we decided to make the pictures on a scale of 600 feet to the inch, meaning that each seven-by-nine-inch picture would take in nearly a square mile of territory. A moment's figuring, knowing the scope of the standard camera, showed that to obtain this scale the plane would fly at an altitude of 7,200 feet. The higher the airplane flies, the smaller the scale and the more territory is included in each picture.

WE ASSEMBLED the four Government "quadrangle" maps that showed Nassau County, and drew flight lines across them. These were the lines along which the pilot would steer the plane, by compass for direction and by altimeter for height, while the photographer took pictures. The lines were purposely drawn so close together so that the pictures would overlap about sixty percent. This is because a directly vertical picture is the only strictly accurate representation of any but a perfectly flat surface. Thus we were able to use only the accurate center part of each picture.

The camera used was the same one employed for all our mapping—a standard make of aerial camera using roll film and taking 100 pictures, each seven by nine inches, to the roll. The long "focal length," or distance of lens from film in such a camera, permits larger pictures of distant objects, just as a telescope magnifies them more than a short-barreled field glass. The lens, in its projecting snoutlike barrel, is a large one to let enough light through for high-speed photography. Of course there are no "time exposures" in air mapping; the plane's movement makes rapid snapshots obligatory.

BEFORE we started taking pictures, the pilot would fly along one of the lines timing himself. Knowing the time it took and the number of pictures to be made, the photographer can reckon the intervals in seconds at which to click his camera, allowing a few pictures extra for overlap. So, on any fine day, our planes were in the air shooting pictures over Long Island. Meanwhile a ground survey party started at United States Coast and Geodetic survey marks on the south shore and triangulated, or measured the distances, across the island to the north shore. The object was to obtain a "control" chart locating several landmarks exactly as a guide for piecing together the photographs. Contrary to popular impression, air mapping does not dispense entirely with ground surveying. They work together. But the simple survey needed for an air map, to establish a few reference points, is not to be confused with the elaborate and costly ground survey to locate rivers, roads, and buildings when the entire map is to be done from the ground. The camera takes in every detail to the smallest tree, more faithfully than the best surveyor.

When the photographs for the Nassau map had been taken, they were hurried to our laboratory and developed in a totally dark room. The films are so sensitive to all kinds of light that even the conventional photographic red lantern used in developing ordinary films would ruin them. Prints were then made from film negatives on paper.

A map assembled from the first photographs would be of enormous size. One such map was actually made—a huge mosaic twenty-eight by twenty-one feet. But for convenience in handling, the (Continued on page 156)

How Air Camera Men Map Unseen Places

(Continued from page 155)

map had to be reduced in size. Therefore, with the ground survey as a basis, individual pictures were assembled on fourteen mounts of wall board, each eight feet high and seven feet wide. We took care to correct any distortion caused by the earth's curvature, which made the top of the map about three or four inches shorter than the bottom. Then the boards were set up in front of a copying camera and each board rephotographed by sections, on a reduced scale, upon glass plates twenty by twenty-four inches in size.

Prints from these large negatives were made in an ingenious machine that assures sharpness and clear detail. A vacuum pump sucks out the air between negative and paper and squeezes them together tighter than a thumb caught in a door jamb. Pasted up, the prints were used to make maps of handy dimensions—twelve by eight and a half feet, and smaller, in a variety of sizes.

IN ADDITION, certain sections of the map, of particular interest, were enlarged to as large a scale as one hundred feet to the inch. This was done in a special enlarging camera built to our specifications, probably the only one of its kind in the world. It handles twenty-by-twenty-four-inch glass negatives. Powerful mercury vapor lamps behind the wall in an adjoining room supply the light used to imprint the enlarged image upon the sensitive enlarging paper.

The camera is focused by a precisely graduated scale, charted for any degree of enlargement or reduction, instead of by eye: It is merely necessary to set the camera and fire away. As an indication of the standard of accuracy we maintain, we found it necessary to avoid one well-known make of enlarging paper.

It would be perfectly satisfactory for ordinary photographic work, but we have discovered that in drying it shrank five percent more in one direction than it did in the other. That would spoil the air map because distances measured upon it would no longer be correct.

The completed tax map of Nassau County is a fair example of the benefits of air mapping. It saved the county about $100,000 in the first cost of mapping; a ground survey would have cost approximately $125,000, while the airplane did it for a fifth of the cost. Four or five departments so far have had occasion to use it, and through this, in a year and a half, the map saved Nassau County $200,000 more. One unexpected use is in mosquito control. Bogs and marshes are clearly revealed on the map, and lines for drainage ditches can be laid out directly upon it. Although the practice of making air maps has been customary for several years, we are at present just commencing to find out what can be done with them.

Moth's Birth Rings Bell

THE birth of a royal prince or princess is usually hailed with the pealing of chimes, but in the new Slough Entomological Laboratory in London, England, a bell rings every time a moth is born. The entomologists in charge of the laboratory find it necessary to keep accurate records of their study specimens, including the exact time of their birth. To make this possible, they have constructed a device consisting of a small platform suspended from a spring. The pupa from which the moth is to emerge is placed on this platform. When the insect is born, the spring flies up and this action results in the ringing of a bell.

Explore Weird Island of the Dead

(Continued from page 28)

almost every natural cave was used for the disposal of corpses.

How many people once inhabited the island? This question, too, is shrouded in mystery. According to native tradition, it was populated by many clans, almost perpetually at war with each other. The immense amount of labor performed by the image makers and tomb builders, provided it was not stretched over centuries, indicates that the island may once have teemed with people. On the other hand, the limited area of tillable soil precludes the possibility of a dense population at any one time and gives weight to the "sunken continent" theory.

ALTHOUGH historical records conflict, there is little doubt that in more recent times the population has been at least ten times as numerous as it is now.

Admiral Jacob Roggeveen, of the Dutch navy, who discovered the island on Easter Sunday, April 7, 1722—a circumstance to which it owes its name—wrote that "several thousand" natives surrounded him and his men upon landing. According to a certain Behrens, a member of the expedition, who may not have disembarked but merely viewed the giant statues from shipboard, the male inhabitants were "children of Goliath," twelve feet tall. The women, he wrote, were "only" ten feet tall. Measurements of skeletons in the oldest tombs have shown that the tallest Easter Islander was a little short of six feet.

Fifty-two years after Roggeveen's discovery, Captain James Cook, famous English mariner, placed the population at only 600 or 700. Later explorers estimated it at 1,500, 2,000, and even 20,000.

Whatever the actual number, it was greatly reduced in 1863, when Peruvian slave-raiders kidnapped the majority of able-bodied men and carried them off to work in the guano deposits of the Chincha Islands and on plantations in Peru. Only a small group was later freed, and of these all but two died of smallpox on the homeward trip. The survivors infected most of the women, children, and old men left on the island, which was almost decimated as a result. But when the last party to explore it, that headed by Dr. and Mrs. Scoresby Routledge, British scientists, reached it in March, 1914, they found the population had again increased to a little over 200.

The early Easter Islanders who built the formidable burial platforms, called "ahu" by the natives, must have had considerable engineering skill. The giant tombs consist of a long stone wall, running parallel with the ocean. The stones, some of which are six feet long, are fitted together without cement. On the land side they are buttressed with a slope of masonry, cunningly constructed to haul the huge images to the top. The burial vaults were underneath the slope. The ahu usually carried from six to twelve images. The largest served as a pedestal for fifteen of the enormous busts.

THERE are between 600 and 700 of the fantastic stone figures on the island; in the quarry alone there are ninety-three, forty of which are finished. The tallest are more than thirty feet; one, an unfinished monster, measures seventy feet. Its weight is estimated at 250 tons—the heaviest whale ever caught weighed 147 tons. A few are only six feet long, and there are even smaller ones. Those on the ahu were from twelve to twenty feet high and were topped by a curious crown or hat, hewn out of red volcanic rock obtained in a small crater near Cooks Bay. The brim of this headpiece projected over the eyes of the figure. To this day, the Easter Islanders sport straw "toppers" of the same

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Explore Weird Island of the Dead

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general shape, and worn in a similar fashion.

All of the statues are half-length figures, with the hands almost meeting in front, at the base. In every case the head is long, with a long, low-bridged nose, somewhat pouting lips, and peculiar ears cut in the form of ropes. The expression is stoical, solemn, severe.

Not a single one of the ahu images is now standing in its original place, and most of them are damaged. Fairly reliable story-tellers among the oldest men ascribe this condition to comparatively recent clan warfare, in which the busts were hauled down with ropes.

BUT how did the ancient workers get them out of the quarry, up hill and down dale, and transport them to the platforms on the coast? The natives explain it in their one favorite word, "mana"—magic. Possibly, a system of chocks and wedges was used to lift them, a slide made to launch them from the crater to level ground, and the rest of the hauling done with hempen ropes.

One visitor to the island, who found large circular holes drilled deep in the rock of the image mountain, thought that the statues may have been moved by an ingenious species of prehistoric aerial trolley. High poles, he fancied, may have been wedged in the openings, and from the top of the beams to the plain below strong thick ropes may have been stretched down which both men and cargo passed, yams being used for lubrication. Unfortunately for this theory, there never has been, so far as anyone knows, sufficient lumber on the island to make a hatrack, not to mention trolley poles.

But aside from the ahu and the images, there are other mysterious relics on this island of the dead. At Orongo, in the southwest, stands a long-deserted village of nearly 100 stone houses, built against a terrace of rock. The walls are often five feet thick, but the tiny doors are only twenty inches high and nineteen inches wide. Paintings of birds, animals, faces, and geometric figures in red, black, and white decorate the walls. Near the huts, some of the rocks are carved into curious shapes, representing human heads, turtles, birds, fish, and weird creatures never seen on land or sea.

Some sixty years ago, the mystery was further deepened by the finding of seven ancient wooden tablets and a number of small wooden household gods. It is assumed they were made of driftwood. The tablets are covered with hieroglyphics, a picture writing in which human figures, beasts, and birds play prominent parts. Paymaster William J. Thomson, who visited the island in 1888 aboard the U. S. S. *Mohican* and who made a study of the place for the Smithsonian Institution, deciphered parts of two of the tablets with the aid of an old chief.

ONE of the translations describes a country intersected by paved roads, and indicates, by references to severely cold weather, that Easter Island, now in the subtropics, may at one time have undergone great climatic change. The writing on the other tablet is of a purely religious nature. Reminiscent of the psalms of David, it appears to be a hymn of praise, poetic in quality and monotheistic in theme, to a supreme god, who is called "the Great King."

Were these tablets inscribed by the same people who carved the huge images and built the massive tombs? And did they, or others, cut the wooden idols and erect the strange stone houses?

These and the other Easter Island enigmas may be solved after the Johnson expedition explores this mysterious little patch of dry land in the South Pacific.

Fortunes That Farmers Throw Away

(Continued from page 21)

ilar fruits formerly were thrown away. Now they are heated in retorts to yield a valuable grade of charcoal like that used in war-time gas masks, as well as methanol, acetic and other acids, and still other chemical materials. From seeds removed from raisins or recovered in the manufacture of grape juice "sweet oil" is made.

Apple cores and skins have become a commercial source of pectin, the colloidal material which makes jellies "jell." Peanut and pecan shells are under further study by growers.

The small, damaged, or poor-looking fruits from the California orange or lemon orchards are perfectly wholesome but undesirable for the general market. Aided by a local laboratory of the United States Department of Agriculture, the citrus growers have developed manufacturing methods and markets for orange and lemon juices and oils, for citric acid made from these fruits, for the same jelly-making pectin made from apples, and for other by-products. The ultimate pulp, from which all juice, sugar, oil, and pectin have been extracted, is useful for stock food.

THESE are examples of how chemistry has aided well-organized, closely-centered kinds of agriculture. Others are possible. Asparagus canning, for example, still has a large unused by-product of the lower ends of asparagus stalks, waiting for some chemist to find useful products in them. Grape skins are still not so useful as their chemical content of acids, vegetable dyes, and vitamines may some day make them. The potato industry, at least where these vegetables are sliced, canned, or made into other potato products, has a potentially useful by-product of skins.

Present public interest in vitamines and mineral salts for human diets probably provides opportunity of utilizing wasted parts of spinach plants, onion tops, cull carrots, extra leaves from the heads of lettuce and cabbage, cull cucumbers, and other green-leaf by-products of the vegetable industry as chemical sources of these necessary food materials; to be treated chemically as vitamines are now extracted from yeast or perhaps merely to be sold in dried and powdered form as useful substitutes for the vegetables themselves when these are scarce. Cull tomatoes have already been used in this way to yield a drinkable juice containing vitamines and mineral salts.

BUT these are organized industries. How can chemistry be applied to diffuse, absolutely unorganized agriculture?

Professor Sweeney and his associates have an answer. What they foresee as an outcome of the present cornstalk company is a network of small factories scattered over the corn belt states, like creameries in a country devoted to dairying. To these factories farmers will bring their cornstalks. Manufacturing and the preparation of chemical products will be done by the factory, and the farmer will receive a cash price for his cornstalks in addition to whatever he now receives for his corn.

This plan cannot but appeal to everyone who knows agricultural America for the reason that it requires a minimum of coöperation from the farmers themselves, who are notoriously difficult to organize or to interest in coöperative plans. Individual farmers need not sell their cornstalks to the factories unless they like. For a long time there will be plenty of cornstalks to go around even if a fair proportion of farmers hold aloof. And gradually the farm population not only will draw able, cooperative recruits back from the cities by the universal magnet of more money, but also will learn that coöperation pays. This is why the million-dollar bet on cornstalks seems a promising event for the American farm.

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That's why thousands of service station men advise you to use Ethyl in your own car. They know that *any* car performs better with Ethyl Gasoline in its tank.

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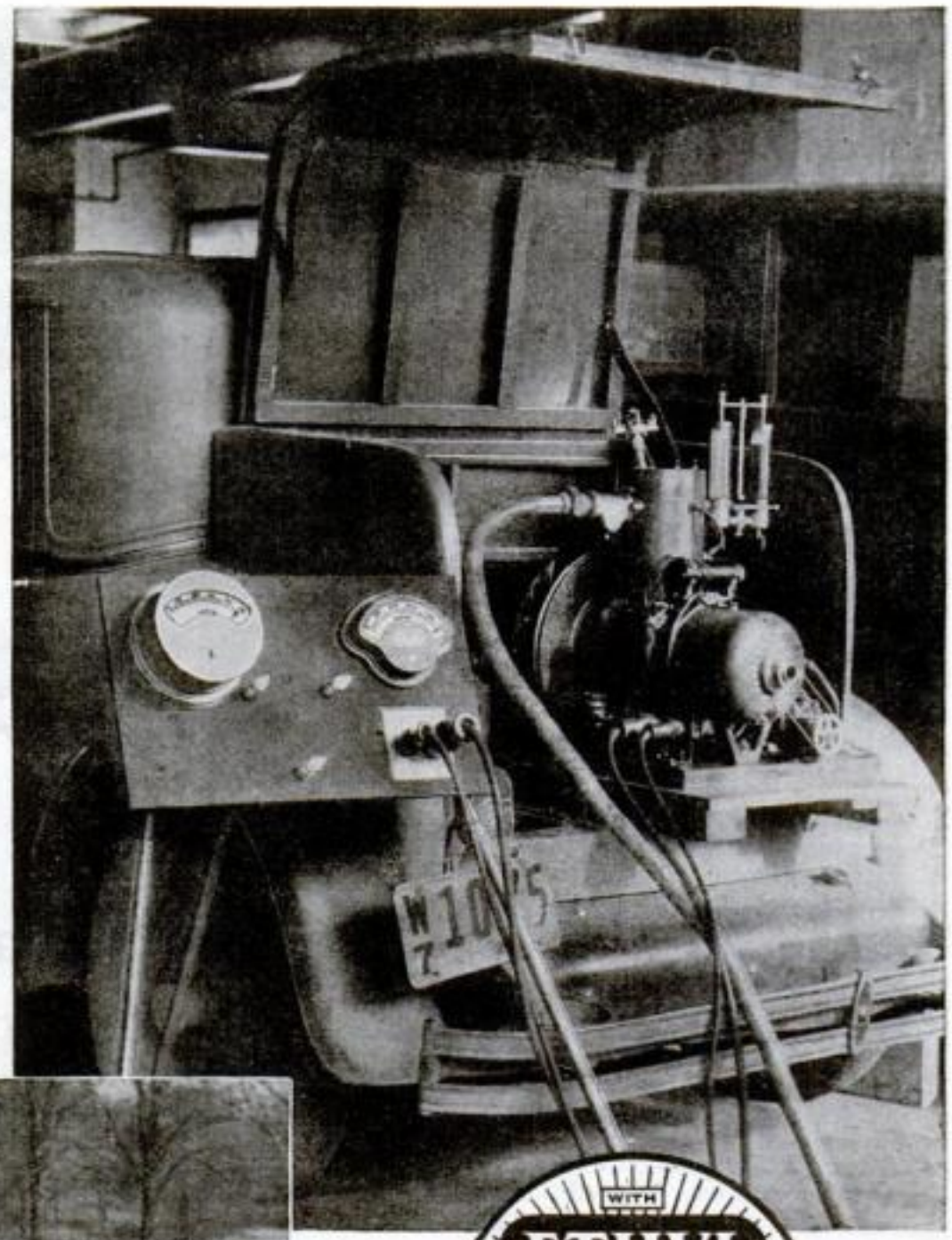
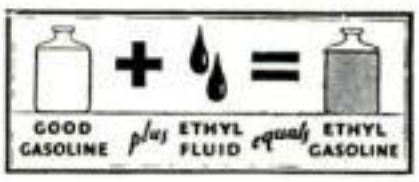


Fitted into the rear of this car is the "knock" demonstration machine. (Above at right) The machine ready for action.



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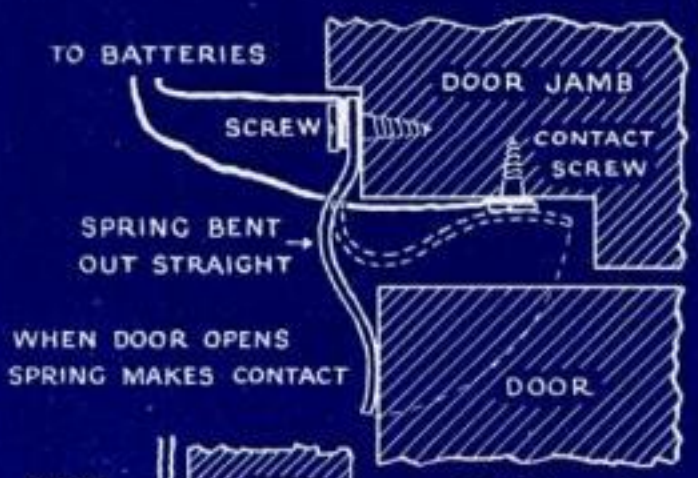
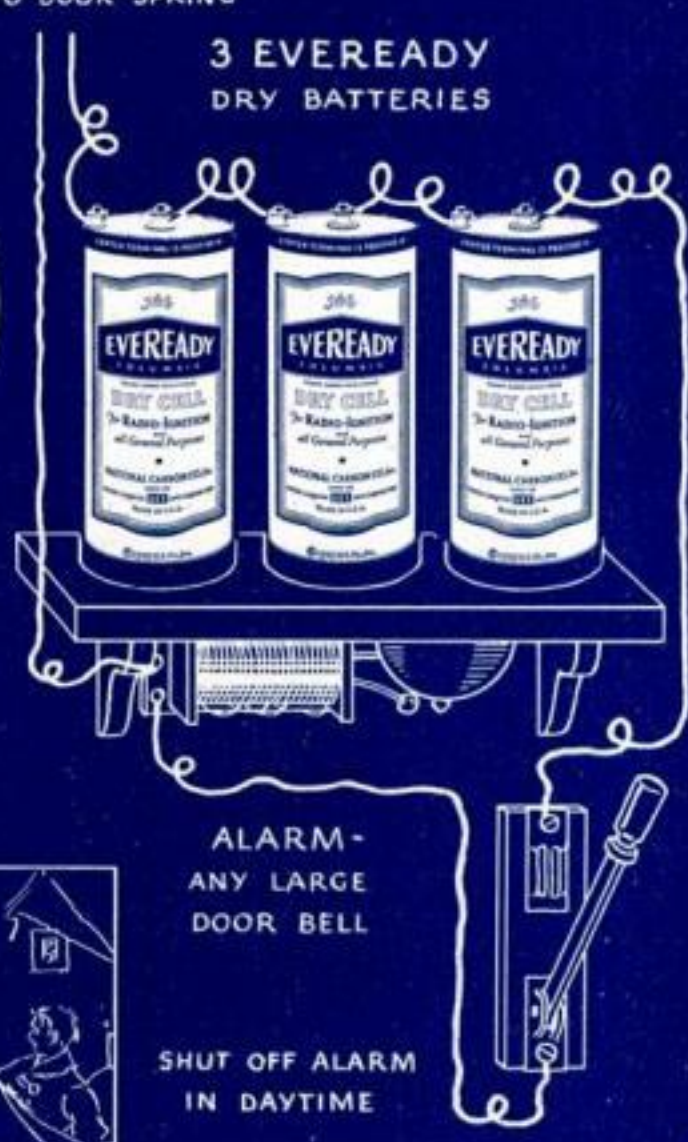


SPRING HIDDEN DURING DAYTIME IN GROOVE CUT IN JAMB ABOVE DOOR



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